## 3.4. Marine Mammals

Marine mammals discussed in this section include species likely to be found in Puget Sound. Cetaceans (including whales, dolphins, and porpoises) live exclusively in aquatic environments, whereas pinnipeds (seals and sea lions) rest and bear their young on marine shorelines. Terrestrial mammals such as river otters and mink that primarily occur in freshwater environments are discussed in Section 3.6.

### 3.4.1. Affected Environment

#### 3.4.1.1. EXISTING CONDITIONS

Eight marine mammal species have been documented in Hood Canal waters: humpback whale (*Megaptera novaeangliae*), Steller sea lion (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*), harbor seal (*Phoca vitulina*), transient killer whale (*Orcinus orca*), gray whale (*Eschrichtius robustus*), Dall's porpoise (*Phocoenoides dalli*), and harbor porpoise (*Phocoena phocoena*) (Table 3.4–1). With the exception of the Steller sea lion, these species may potentially occur year round in Hood Canal. One species (humpback whale) that has been detected in Hood Canal is federally listed under the ESA (Table 3.4–2).

Harbor seals and California sea lions are the most prevalent species of marine mammal in the vicinity of the Bangor waterfront. Harbor seals are present year round in Hood Canal and occur regularly at NAVBASE Kitsap Bangor. The California sea lion is also present year round, but with minimal numbers occurring June through August. The Steller sea lion is present from fall to spring (September to May). Because these three species are predictably present at NAVBASE Kitsap Bangor, they are included in the analysis. Further, harbor porpoise have been documented on multiple occasions in Hood Canal since 2011, and consequently are also included in the analysis. Humpback whales are occasionally present in small numbers in Puget Sound, and after an absence of sightings for over 15 years, individual humpback whales were seen in Hood Canal south of the Hood Canal Bridge in early 2012, and in early 2015. For this reason they are included in the analysis. Pods of transient killer whales have occurred on only two occasions in Hood Canal in the past decade. However, because these occurrences involved lengthy stays by the whale pods, this stock is included in the analysis.

Two rare species that have been documented in Hood Canal waters are not carried forward in the analysis. Dall's porpoise has only been documented once during marine mammal surveys (Tannenbaum et al. 2009a) and, therefore, is not included in the analysis. Gray whales have been infrequently documented in Hood Canal waters over the past decade, but the sightings are an exception to the normal seasonal occurrence of gray whales in Puget Sound feeding areas. Consequently, because gray whales are unlikely to be present in Hood Canal, the species is not included in this analysis.

The Southern Resident killer whale stock is resident to the inland waters of Washington State and British Columbia; however, it has not been seen in Hood Canal since 1995. This species is included in the analysis of indirect effects because its prey base includes salmonid species that may be affected by the project.

## Table 3.4–1. Marine Mammals Historically Sighted in Hood Canal

| Species | Stock(s) Abundance[1] | Season(s) of Occurrence | Relative Occurrence[a] |
|---|---|---|---|
| **Humpback Whale**<br>*Megaptera novaeangliae*<br>CA/OR/WA stock | 1,918[3]<br>(CV=0.03) | Year round in Puget Sound | Rare |
| **Steller sea lion**<br>*Eumetopias jubatus*<br>Eastern U.S. stock/DPS | 63,160 – 78,198[2] | Fall to spring (late September – May) | Seasonal |
| **California sea lion**<br>*Zalophus californianus*<br>U.S. stock | 296,750[3] | Year round in Hood Canal | Seasonal |
| **Harbor seal**<br>*Phoca vitulina*<br>Hood Canal stock | 3,555[4] | Year round; resident species in Hood Canal | Likely |
| **Killer whale**<br>*Orcinus orca*<br>West Coast transient stock | 243[2, b] | Year round in Puget Sound, last seen in Hood Canal in 2005 | Rare |
| **Harbor porpoise**<br>*Phocoena phocoena*<br>WA inland waters stock | 10,682[3]<br>(CV=0.38) | Year round | Likely |
| **Dall's porpoise**<br>*Phocoenoides dalli*<br>CA/OR/WA stock | 42,000[3]<br>(CV=0.33 | Year round in Puget Sound, last seen in Hood Canal in 2008 | Rare |
| **Gray whale**<br>Eastern North Pacific | 19,126[3]<br>(CV=.071) | Migrants and a few individuals present in spring in northern Puget Sound | Rare |

**Sources:**

1. NMFS marine mammal stock assessment reports at: http://www.nmfs.noaa.gov/pr/sars/species.htm
2. Allen and Angliss 2014
3. Carretta et al. 2014
4. Based on Jeffries et al. 2003 sightings and London et al. 2012 correction factors.

CA = California; CV = coefficient of variation; OR = Oregon; WA = Washington

a. Rare: The distribution of the species is near enough to the area that the species could occur in the area or there are a few confirmed sightings (e.g., humpback in Hood Canal; transient killer whale in Hood Canal); Likely: Confirmed and regular sightings of the species in the area year round (e.g., harbor seal); Seasonal: Confirmed and regular sightings of the species in the area on a seasonal basis (e.g., California sea lion and Steller sea lion).

b. Minimum population estimate of killer whales that occur in the inside waters of southeastern Alaska, British Columbia, and northern Washington. This estimate does not include whales documented on the outer coast or in California.

**Table 3.4–2. Federally Listed Threatened and Endangered Marine Mammals Potentially Affected by the Proposed Action**

| Wildlife | Federal Listing[1] | Critical Habitat | Critical Habitat at NAVBASE Kitsap Bangor |
|---|---|---|---|
| **Humpback whale** | Endangered<br>*35 FR 18319*<br>*December 2, 1970* | None Designated | None |
| **Southern Resident killer whale** | Endangered<br>*70 FR 69903*<br>*November 18, 2005* | Designated<br>(> 20 ft [6 m] deep)<br>*71 FR 69054*<br>*November 29, 2006* | None; closest critical habitat is 8.5 mi (13.7 km) northeast of base |

ft = feet; FR = Federal Register; km = kilometer; m = meter; mi = mile

1. DPS = Distinct population segment that is discrete from other populations and important to its taxon. A group of organisms is discrete if it is "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, and behavioral factors" (DPS Policy; 61 FR 4722; February 7, 1996). Significance is measured with respect to the taxon (species or subspecies).

Other marine mammal species, including the minke whale and northern elephant seal, occur in inland marine waters of Washington State and British Columbia but are not included in the analysis because they have not been documented in Hood Canal in at least 15 years.

Habitats used by marine mammals in the vicinity of the LWI and SPE project sites include marine intertidal and subtidal zones associated with the nearshore, marine deeper water areas, and manmade structures (i.e., marine vessels, piers, wharves, and associated structures that are in marine waters), as described in Table 3.4–3.

#### 3.4.1.1.1. MARINE MAMMAL HABITAT

##### NEARSHORE MARINE HABITAT

Nearshore marine habitats on the Bangor waterfront include intertidal and nearshore subtidal zones. For purposes of evaluating project impacts the edge of the nonphotic zone, 30 feet (9 meters) below MLLW, is used to bound the nearshore habitat. Pinnipeds (seals and sea lions) haul out of water on intertidal habitat; all other marine mammals occurring in Hood Canal occur in the subtidal zone of nearshore marine waters in addition to deeper water habitats. In Hood Canal, harbor seals (and to a lesser extent California sea lions) haul out on intertidal substrates, including river deltas and rocky outcrops (Jeffries et al. 2000). River deltas in Hood Canal are more accessible for haul-out activities at high tides, when greater numbers of harbor seals haul out (Huber et al. 2001; London et al. 2002). There are no river deltas near the LWI and SPE project sites, and neither harbor seals nor California sea lions have been observed hauled out on intertidal substrates in this area (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a).

Marine mammals occurring or potentially occurring at the Bangor waterfront use the subtidal zone of nearshore habitat to forage for food resources. Prey items range from invertebrates (consumed by seals), fish (consumed by whales, porpoises, seals, and sea lions), or other marine mammals (i.e., transient killer whales primarily consumed harbor seals during their recent occurrences in Hood Canal [London 2006]). In the nearshore community, fish that are consumed by marine mammals include migrating salmonids and forage fish such as surf smelt and

**Table 3.4–3. Marine Mammal Habitats in the Vicinity of the LWI and SPE Project Sites**

| Habitat Type | | Habitat Value | Relative Occurrence of Species in Hood Canal[1] |
|---|---|---|---|
| **Nearshore Marine** | Intertidal Zone | Areas within the intertidal zone provide haul-out sites for seals and sea lions. In Hood Canal, haul-out sites are primarily on river deltas, which occur outside the Bangor waterfront. | **Common:** California sea lion and harbor seal<br>**Occasionally Present:** Steller sea lion |
| | Subtidal Zone | The subtidal zone of nearshore marine waters in Hood Canal provides foraging habitat for seals, sea lions, and transient killer whales. May provide foraging benefits for other marine mammals that occasionally occur in the area. | **Common:** California sea lion, harbor seal<br>**Occasionally Present:** Steller sea lion, harbor porpoise<br>**Rarely Present:** Transient killer whale, gray whale, humpback whale, Dall's porpoise |
| **Marine Deeper Water** | | Same as Subtidal Zone of the Nearshore Marine. | **Common:** California sea lion, harbor seal<br>**Occasionally Present:** Steller sea lion, harbor porpoise,<br>**Rarely Present:** transient killer whale, gray whale, humpback whale, Dall's porpoise |
| **Manmade Structures** | | Manmade structures at and near the LWI project sites represent unique haul-out habitat for California sea lions, which are not known to haul out in groups elsewhere in Hood Canal. | **Common:** California sea lion, harbor seal<br>**Occasionally Present:** Steller sea lion |

Sources: Jeffries et al. 2000; Johnson and O'Neil 2001; Jeffries 2007, personal communication; Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; Navy 2015a

1. Common: consistently present either year round (harbor seal) or during non-breeding season (California sea lion and Steller sea lion); occasionally present: documented at irregular intervals; rarely present: sporadic sightings, not occurring on a yearly basis.

Pacific herring, and some demersal fish. Habitat features in the subtidal zone, such as river mouths and adjacent estuarine habitat, and physical processes, such as eddies and upwelling, can spatially aggregate the forage resources of marine mammals (Hunt and Schneider 1987). For example, during the in-migration of adult salmonids, estuaries and river mouths provide relatively dense concentrations of salmonid prey for seals and sea lions (London et al. 2002; London 2006). Availability of forage resources for marine mammals in the subtidal nearshore is affected by time scales including time of day, season, and year. For example, the availability of prey that migrate vertically in the water column varies based on time of day. Additionally, forage fish are more available during the spawning season and salmonids are more available during periods of migration.

Migrating juvenile salmonids (including Chinook, coho, steelhead, and cutthroat trout) of an appropriate size to attract marine mammals, and adult surf smelt and Pacific herring were identified in beach seine surveys in both the LWI and SPE project areas (Section 3.3.1.1; Bhuthimethee et al. 2009). Their numbers varied at different survey locations on different survey dates, reflecting the use of the waterfront as a seasonal migratory pathway by schooling fish. These data do not indicate any attraction to, or extended residence at, any specific locations on the Bangor waterfront (Section 3.3.1.1).

The LWI project sites include subtidal habitats that support the seasonally available potential prey species described above for marine mammals. These prey species were sampled at a variety of survey sites along the Bangor waterfront, and there is no evidence that the project sites attract any particular concentration of prey with respect to other nearshore areas. The SPE would be located in deeper water habitat from 30 to 75 feet (9 to 23 meters) below MLLW (see Marine Deeper Water Habitat below). Adjacent nearshore marine habitats support the same seasonally available potential prey species observed elsewhere on the Bangor waterfront. Deeper water prey resources are described below.

#### MARINE DEEPER WATER HABITAT

Marine deeper water habitats described in this section refer to inland waters of Washington (Puget Sound including Hood Canal, Strait of Juan de Fuca, and the vicinity of the San Juan Islands). Food resources previously described for the nearshore zone (e.g., fish including salmonids, forage fish, and demersal fish) also occur in marine deeper water habitat. Deeper water habitats at NAVBASE Kitsap Bangor are likely to support migratory prey species (e.g., Pacific herring and juvenile salmonids) found in nearshore waters, in addition to adult/sub-adult salmonids such as Chinook, steelhead, and cutthroat trout. Aggregation of forage resources in marine deeper waters can be affected by the same processes described for nearshore marine habitat, generally resulting in a patchy distribution of forage resources for marine mammals and marine birds (Section 3.5) across time and space (Hunt and Schneider 1987). Although the LWI project would be constructed in shallower water, prey resources in deeper water habitats adjacent to the LWI and SPE project sites are as described in this section.

#### MANMADE STRUCTURES

California sea lions, harbor seals, and Steller sea lions use manmade structures along the Bangor waterfront as haul-out sites. Submarines intermittently dock at four of the overwater structures for service, and both Steller and California sea lions have been observed hauled out on the above-water portion of the submarines at Delta Pier. As many as 122 California sea lions have been observed hauled out on docked submarines, the pontoons that support the PSB, and other structures (Navy 2015a). Harbor seals have been observed on the PSBs, the wavescreen at Carderock Pier, on buoys, barges, and small marine vessels (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; Navy 2015a).

##### *Manmade Structures at the LWI Project Sites*

There are no manmade structures at the LWI project sites. The north LWI project site is approximately 1,000 feet (300 meters) from EHW and the south LWI project site is approximately 900 feet (275 meters) from Delta Pier. Submarines berthed at Delta Pier provide haul-out locations for California and Steller sea lions. Harbor seals haul out on the pontoons of the PSBs attached to Delta Pier and EHW-1.

*Manmade Structures at the SPE Project Site*

Unconfirmed reports of the Port Operations crew indicate that harbor seals use the northeast side of the Service Pier for pupping.

#### 3.4.1.1.2. Threatened and Endangered Marine Mammal Species

The Biological Assessment for the LWI and SPE project addressed two ESA-listed marine mammals: humpback whale and Southern Resident killer whale. The humpback whale is included in the analysis because it has been sighted in Hood Canal on several occasions since 2012. The Southern Resident killer whale does not occur in Hood Canal, but it is included in the analysis because the project may adversely affect its prey (Hood Canal salmonid species).

HUMPBACK WHALE

*Status*

Humpback whales were listed as endangered under the ESA in 1973 due to depletion by commercial whaling (35 FR 18319). A recovery plan for humpback whales was finalized in November 1991 (NMFS 1991). Critical habitat has not been designated for humpback whales. NMFS proposed on April 20, 2015 to reclassify the species into 14 distinct population segments, ten of which do not warrant ESA listing (80 FR 22304). Two of the humpback whale DPSs migrate and feed along the west coast of Washington. Under the proposed rule, the Mexico DPS, which breeds on the Pacific coast of Mexico and feeds along the California/Oregon/Washington coast would not be listed. The Central America DPS, which breeds along the Pacific coast of Costa Rica, Panama, Guatemala, El Salvador, Honduras, and Nicaragua and primarily feeds offshore of California and Oregon, with some feeding off northern Washington/southern British Columbia, would be listed as threatened.

*Range of Humpback Whale*

Humpback whales in the North Pacific migrate seasonally from northern latitude feeding areas in summer to low-latitude breeding areas in winter. Feeding areas are dispersed across the Pacific Rim from California to Hokkaido, Japan. Within these regions, humpback whales have been observed spending the majority of their time feeding in coastal waters. More than half of the North Pacific Ocean humpback whales feed in U.S. waters. Breeding areas in the North Pacific are more geographically separated than the feeding areas and include (1) regions offshore of Central America; (2) regions offshore of mainland Mexico, the Revillagigedos Islands, and Baja California; (3) Hawaii; and (4) regions offshore of Japan and the Philippines. About half of the humpback whales in the North Pacific breed and calve in the U.S. waters off Hawaii.

*Population Size*

The Mexico DPS abundance is thought to be 6,000 to 7,000 individuals (Calambokidis et al. 2008) or higher (Barlow et al. 2011). Estimates of population growth trends do not exist for the Mexico DPS by itself, but population growth throughout most of the primary feeding areas of the Mexico DPS (from California to the Gulf of Alaska) suggests that this DPS is unlikely to be declining. The abundance of the Central America DPS is thought to be 500 to 600 individuals with unknown trend (Calambokidis et al. 2008; Barlow et al. 2011).

*BEHAVIOR AND ECOLOGY*

Humpback whales spend the majority of their time during summer months on mid- to northern-latitude feeding areas where they build up fat stores that they will live off of during the winter. Humpback whales filter feed on tiny crustaceans (primarily krill), plankton, and small fish and can consume up to 3,000 pounds (1,360 kilograms) of food per day. In winter they migrate to calving areas in subtropical or tropical waters, undertaking the longest recorded migrations of any mammals. During migration, humpback whales remain near the surface of the ocean. While feeding and calving, humpback whales prefer shallow waters.

*OCCURRENCE OF HUMPBACK WHALE IN THE ACTION AREA*

Humpback whales were sighted in Hood Canal on 8 days in January and February 2012, 1 day in May 2013, and 5 days in January and February 2015 (Orca Network 2015). Review of the multiple sightings in 2012 indicated the occurrences were one individual (Calambokidis 2012, personal communication). Locations in 2012 included Dabob Bay and other locations south to the Great Bend. In May 2013 a humpback whale was observed north of Hood Canal Bridge heading toward Port Gamble. In 2015 single humpback whales were observed near NAVBASE Kitsap Bangor and elsewhere in Hood Canal.

Prior to the 2012 sightings, there were no confirmed reports of humpback whales entering Hood Canal (Calambokidis 2012, personal communication). No other reports of humpback whales in Hood Canal were found in the Orca Network database, the scientific literature, or agency reports. Construction of the Hood Canal Bridge in 1961 may have contributed to the lack of historical sightings (Calambokidis 2010, personal communication). A few records of humpback whales near Hood Canal, but north of the bridge, were found in the Orca Network database.

Construction and operation of the LWI and SPE would not be likely to adversely affect the humpback whale directly, because humpback sightings within Hood Canal are rare and, based on past evidence as noted above, it is unlikely that humpbacks would occur in the Action Area during the short duration of pile driving activity. In the event a whale did enter the Action Area, active pile-driving would be stopped by the monitors immediately upon sighting. Indirect effects of the Proposed Actions on transiently occurring humpbacks from a reduction of their regional prey base or other habitat-related effects are not predicted (see Sections 3.3.1.1. and 3.4.1.1.1 for background). For these reasons, the FEIS does not perform detailed impact analyses on the humpback whale.

SOUTHERN RESIDENT KILLER WHALE

*STATUS*

Southern Resident killer whales were listed as endangered under the ESA in 2005 (70 FR 69903), a recovery plan was approved in 2008 (73 FR 4176), and critical habitat was designated in 2006 (71 FR 69054). A combination of factors including ocean conditions, reductions in prey resources, disturbance from vessel traffic, and toxins most likely contributed to the whales' decline (NMFS 2008b). Critical habitat for the Southern Resident killer whale does not include Hood Canal (NMFS 2006b), and NMFS has not confirmed any sightings of this whale stock in Hood Canal since 1995 (NMFS 2008b). Ongoing genetic and morphological studies of Puget Sound killer whales indicate that Southern Resident killer whales are a distinct population. Although their geographic ranges overlap considerably with transient and Northern Resident killer whales, which inhabit the Strait of Georgia and coastal British Columbia, they do not appear to associate or interbreed with the other killer whale populations (Ford et al. 2000).

*RANGE OF SOUTHERN RESIDENT KILLER WHALE*

The Southern Resident killer whale stock consists of three pods (J, K, and L) that reside primarily in Puget Sound, the Strait of Juan de Fuca, and the Strait of Georgia (British Columbia) during the spring, summer, and fall (McCluskey 2006; Hauser et al. 2007; Hanson and Emmons 2011). Less information is available on their winter distribution and movements, but opportunistic sightings and dedicated surveys have detected Southern Resident pods in coastal waters off Oregon, Washington, Vancouver Island, the mouth of the Columbia River, and as far south as Monterey Bay, California (Ford et al. 2000; Krahn et al. 2004; Black 2011; Northwest Fisheries Science Center 2013). There have been no confirmed sightings of Southern Resident killer whales in Hood Canal since 1995 (Unger 1997; Bain 2006; NMFS 2006b).

*POPULATION SIZE*

In July 2014 the population consisted of 80 individuals (Center for Whale Research 2014). Population censuses from 1974 to the present show variations from 71 individuals in 1974 to 99 individuals in 1995 (Carretta et al. 2014).

*BEHAVIOR AND ECOLOGY*

Unlike transient killer whales, which prey on marine mammals, Southern Residents primarily consume salmonids (especially Chinook and chum salmon), and also Pacific halibut, rockfish species, and Pacific herring (Ford and Ellis 2005; Hanson et al. 2010; Hanson 2011).

*OCCURRENCE OF SOUTHERN RESIDENT KILLER WHALE IN THE ACTION AREA*

Southern Resident killer whales have not been detected in Hood Canal since 1995. The species is carried forward in the impacts analysis for the proposed projects because the projects may indirectly affect killer whales through effects on their preferred prey species. They are not carried forward in the analysis of potential noise impacts.

3.4.1.1.3. NON-LISTED MARINE MAMMALS

STELLER SEA LION

*STATUS*

The Steller sea lion is distributed from Japan through the North Pacific, including the Aleutian Islands, central Bering Sea, Gulf of Alaska, southeast Alaska, and south to central California (55 FR 49204). The Steller sea lion was listed as threatened under the ESA in 1990 (55 FR 49204), and critical habitat was designated 3 years later (58 FR 45269). In 1997, NMFS reclassified the Steller sea lion into distinct western and eastern population segments based on demographics and genetics, as authorized by NMFS (62 FR 30772). The eastern DPS, which occurs from southeast Alaska southward to California (east of 144˚ West longitude), was delisted under the ESA in November 2013 (78 FR 66140).

*RANGE OF EASTERN DPS OF STELLER SEA LION*

There are no known rookeries in Washington State, but eastern DPS Steller sea lions are present along the outer coast of Washington at four major haul-out sites year round (NMFS 2008a). These animals are most likely immature or non-breeding adults from rookeries in other areas (NMFS 2008a), including the southern coastline of Vancouver Island. In addition, Steller sea lions are occasionally present in Puget Sound at the Toliva Shoals haul-out site in south Puget Sound (Jeffries et al. 2000), a haul-out near Marrowstone Island (NMFS 2010), a net pen in Rich Passage, and navigation buoys in Puget Sound (Jeffries 2012, personal communication). Steller sea lions have been observed hauled out on submarines at Delta Pier from 2008 to the present during fall through spring months (late September to May) (Navy 2015a). As many as 13 Steller sea lions have been reported on a given day at this location (Navy 2015a).

*POPULATION SIZE*

The eastern DPS has continuously increased at an annual rate of 3 percent over the past 30 years. The most recent population estimate for the Eastern stock ranges from 63,160 to 78,198 individuals (Allen and Angliss 2014).

*BEHAVIOR AND ECOLOGY*

Steller sea lions occupy all marine water habitats for foraging and they haul out on manmade structures such as jetties, buoys, rafts, floats, and vessels (Jeffries et al. 2000; Navy 2015a), and natural sites such as islands and rocky shorelines. They are opportunistic predators, feeding primarily on fish and cephalopods, and their diet varies geographically and seasonally (Merrick et al. 1997). Foraging habitat is primarily shallow, nearshore and continental shelf waters; rivers; and also deep waters (Reeves et al. 2008; Scordino 2010). All reported occurrences of Steller sea lions on NAVBASE Kitsap Bangor have been of animals hauled out on submarines, but it is likely they also forage in surrounding waters. Their prey is not well documented in these marine waters, but they are expected to be opportunistic foragers, similar to California sea lions.

*OCCURRENCE OF STELLER SEA LION AT THE LWI PROJECT SITES*

Steller sea lions have not been detected at either LWI project site. They haul out on submarines docked at Delta Pier, which is located approximately 1 mile (1.6 kilometers) from the north LWI project site, and 1,000 feet (300 meters) from the south LWI project site.

*OCCURRENCE OF STELLER SEA LION AT THE SPE PROJECT SITE*

Steller sea lions have not been detected at the SPE project site, which is located approximately 0.9 mile (1.5 kilometers) from the Steller sea lions' haul-out location at Delta Pier.

HARBOR SEAL

*RANGE OF HARBOR SEAL*

Harbor seals are the only species of marine mammal that is consistently abundant and resident year round in Hood Canal (Jeffries et al. 2003). The geographic distribution of harbor seals includes the U.S. west coast from Baja California north to British Columbia and coastal Alaska, including southeast Alaska, the Aleutian Islands, the Bering Sea, and the Pribilof Islands (Carretta et al. 2014). For management purposes harbor seals are separated into separate stocks along the west coast of the continental U.S, including stocks in California, the outer coast of Oregon and Washington, and Washington inland waters (Carretta et al. 2014). Recent genetic evidence indicates that three genetically distinct populations occur within the Washington inland waters stock, including a Southern Puget Sound stock, a Washington Northern Inland Waters stock, and a Hood Canal stock (Huber et al. 2010, 2012; Carretta et al. 2014). The Hood canal stock is the only population that is expected to occur within the project area. Harbor seals may occur anywhere along the Bangor waterfront in subtidal or deeper waters, and have been observed in every month based on surveys conducted from 2007 to 2015 (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; HDR 2012; Hart Crowser 2013b; Navy 2015a).

*POPULATION SIZE*

Harbor seals are the most abundant marine mammal in Hood Canal (Jeffries et al. 2003). Currently published population estimates were derived from data collected in 1999 (Jeffries et al. 2003) which calculated a population size of approximately 1,000 individuals. However, more recent unpublished data (2004, 2006, 2010, and 2013) show that although the population size is variable from year to year it has increased (DeLong 2015, personal communication) (Table 3.4–1).

*BEHAVIOR AND ECOLOGY*

Harbor seals use all marine habitats, such as, the intertidal zone and manmade structures are used for haul-out activities, and subtidal nearshore marine, inside marine deeper water habitats, and the lower reaches of rivers are used for foraging (Reeves et al. 2008) (Table 3.4–3). The main haul-out locations for harbor seals in Hood Canal are on river delta and tidally exposed areas at the Quilcene, Dosewallips, Duckabush, Hamma Hamma, and Skokomish River mouths, with the closest haul-out area located 10 miles (16 kilometers) southwest of NAVBASE Kitsap Bangor at the Dosewallips River mouth (London 2006). Modeled haul-out behavior of Hood Canal harbor seals indicates that the highest probability of haul-out occurs during the 1.5 hours after high tide, and is influenced by human disturbance, the timing of pupping and molting, and the presence of marine predators (London et al. 2012).

Harbor seals mate at sea and females in most areas give birth during the spring and summer. The Navy has documented harbor seal pupping at NAVBASE Kitsap Bangor, from June through August, with peak births occurring in July (Navy 2015a). This is earlier and shorter than described previously for Hood Canal. The pupping season for the Hood Canal population has been described inconsistently, extending anywhere from mid-July through January (Ferrero and Fowler 1992; Huber et al. 2001; Seekins 2009).

Harbor seals are opportunistic foragers, and their diverse diet varies by location and season (Lance and Jeffries 2006, 2007; Luxa 2008; Lance et al. 2012). Their diet in Puget Sound includes many prey species that are present in nearshore and deeper waters, including Pacific herring, Pacific hake, walleye pollock, shiner perch, Pacific sand lance, and adult and out-migrating juvenile salmonids. Analysis of scat samples indicates that Pacific hake, Pacific herring, and salmon species are the three major components of the harbor seal diet in Hood Canal (London 2006). Harbor seals in Hood Canal feed on returning adult salmon, including pink salmon during odd years and threatened summer-run chum, where the average percent escapement of summer-run chum consumed primarily by harbor seals over 5 years of study was 8 percent (London 2006).

*Occurrence of harbor seal at NAVBASE Kitsap Bangor*

Harbor seals have been observed swimming in the waters along NAVBASE Kitsap Bangor in every month of surveys conducted from 2007 to 2015 (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; HDR 2012; Hart Crowser 2013b; Navy 2015a). Harbor seals accounted for the vast majority of marine mammal sightings during the TPP and EHW-2 construction projects (HDR 2012; Hart Crowser 2013b). At the EHW-2 project site, harbor seals have been observed hauling out on floats/docks. Most documented occurrences of harbor seals hauling out along the Bangor waterfront were on pontoons of the PSBs and on manmade floating structures near KB Dock and Delta Pier. On two occasions, the group size was four to six individuals near Delta Pier. Harbor seals also have been observed hauled out on logs and manmade structures such as the floating security fences, wavescreen at Carderock Pier, buoys, barges, and marine vessels (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a).

The first documented birth at NAVBASE Kitsap Bangor was on August 5, 2011, when a harbor seal gave birth on the wavescreen dock at Carderock Pier, approximately 1,000 feet (300 meters) south of the SPE project site. Additional births have been documented at Bangor, but they were not located at the project sites. A harbor seal mother and pup were observed on August 13, 2012, on a dock next to the Magnetic Silencing Facility pier (over 1 mile [1.6 kilometers] north of the north LWI project site and almost 3 miles [4.8 kilometers] north of the SPE project site). Harbor seal afterbirth was found on a floating dock at the EHW-2 project site on August 1, 2013, approximately 0.35 mile (0.57 kilometer) from the north LWI site, and 1 mile (1.6 kilometers) from the south LWI site, and 1.5 miles (2.4 kilometers) north of the SPE project site. In addition, a few days prior on July 25, 2013, at the EHW-2 project site, a pregnant harbor seal hauled out on a workboat and subsequently died. This death was reported to NMFS in accordance with permit requirements.

*Occurrence of Harbor Seal at the LWI Project Sites*

Harbor seals occur in all subtidal and deeper water areas along the Bangor waterfront, and have been observed swimming in the vicinity of the LWI project sites. There is no evidence of a preference for either of these sites. A few records exist of individual harbor seals hauled out primarily on manmade structures on the Bangor waterfront, but none of these records are in close proximity to the LWI project sites (Tannenbaum et al. 2009a, 2011a; Navy 2015a).

*Occurrence of Harbor Seal at the SPE Project Site*

In December 2013, a harbor seal was observed hauled out along the shoreline of NAVBASE Kitsap Bangor at Carlson Spit, just south of the Service Pier (Navy 2015a). A Navy worker anecdotally reported in late 2013 that for the last 13 years harbor seals have been pupping on concrete floats on the northeast side of Service Pier. This has not yet been documented by Navy biologists.

CALIFORNIA SEA LION

*Range of California Sea Lion*

The geographic distribution of California sea lions includes a breeding range from Baja California to southern California. The non-breeding distribution extends from Baja California north to Alaska for males, and encompasses waters of California and Baja California for females (Maniscalco et al. 2004; Reeves et al. 2008).

As many as 122 California sea lions have been observed hauled out on manmade structures (submarines, the floating PSB security fence, and barges) at NAVBASE Kitsap Bangor (Navy 2015a). California sea lions can be present year round, but are typically sighted from late August through June, with peak occurrence in the fall (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; HDR 2012; Hart Crowser 2013b; Navy 2015a).

*Population Size*

An estimated 3,000 to 5,000 California sea lions migrate to Washington and British Columbia waters during the non-breeding season from September to May (Jeffries et al. 2000).

*Behavior and Ecology*

California sea lions use a variety of haul-out substrates, from rocky outcrops to beaches, as well as manmade structures such as navigational buoys (Jeffries et al. 2000), and likely forage in both nearshore marine and inside marine deeper water habitats. Like harbor seals, California sea lions are opportunistic foragers whose diet varies by season and location. In the greater Puget Sound region, California sea lions primarily prey on Pacific hake and Pacific herring (London 2006). In some locations where sea lions and salmon runs co-exist, California sea lions also feed on returning adult and out-migrating juvenile salmonids (review in London 2006).

*Occurrence of California Sea Lion at the LWI Project Sites*

California sea lions have been observed swimming in the vicinity of the LWI project sites, although there is no evidence of any preference for either of these sites. They haul out on submarines at Delta Pier, which is approximately 1 mile (1.6 kilometers) from the north LWI project site and 1,000 feet (300 meters) from the south LWI project site, and also on pontoons of the floating security barrier (PSB).

*OCCURRENCE OF CALIFORNIA SEA LION AT THE SPE PROJECT SITE*

California sea lions have been observed swimming in the vicinity of the SPE project site, which is 0.9 mile (1.5 kilometers) from their haul-out site at Delta Pier.

HARBOR PORPOISE

*RANGE OF HARBOR PORPOISE*

The harbor porpoise is a coastal species found in fjords, bays, estuaries, and harbors (Reeves et al. 2008), using nearshore marine and inside deeper water marine habitats. Along the Pacific coast, this species occurs from Monterey Bay, California, north to the Aleutian Islands and west to Japan (Reeves et al. 2008). Harbor porpoise are known to occur in Puget Sound year round (Osmek et al. 1996, 1998; Carretta et al. 2014), and they may occasionally occur in Hood Canal (Jeffries 2006, personal communication). Harbor porpoises have been observed in deeper water in the vicinity of NAVBASE Kitsap Bangor (Tannenbaum et al. 2011a; HDR 2012; Hart Crowser 2013b).

*POPULATION SIZE*

Surveys from 2002 and 2003 for the inside waters stock of harbor porpoise yielded a corrected abundance estimate of 10,682 individuals (Carretta et al. 2014). Osmek et al. (1998) suggested that harbor porpoise abundance in other inside waters of northern Washington and British Columbia (Strait of Juan de Fuca and San Juan Islands) has likely been stable (has not declined) over the past 5 years. A substantial decline in the abundance of harbor porpoise occurred in southern Puget Sound after the 1940s, and no harbor porpoises were sighted during surveys in 1991 and 1994 in southern Puget Sound (Osmek et al. 1995, 1996). Harbor porpoise observations in northern Hood Canal have increased in recent years (Calambokidis 2010, personal communication).

*BEHAVIOR AND ECOLOGY*

Harbor porpoises are usually seen in small groups of two to five animals. Little is known about their social behavior. Studies of this species in the Gulf of Maine showed that they mature at an earlier age, reproduce more frequently, and live for shorter periods than other toothed whales (Read and Hohn 1995). Females reach sexual maturity at 3 to 4 years and may give birth every year for several years in a row. Calves are born in late spring (Read 1990; Read and Hohn 1995). Dall's and harbor porpoises appear to hybridize relatively frequently in the Puget Sound area (Willis et al. 2004). Harbor porpoises can be opportunistic foragers but primarily consume schooling forage fish (Osmek et al. 1996; Bowen and Siniff 1999; Reeves et al. 2008). Along the coast of Washington, they primarily feed on Pacific herring (C*lupea pallasii*), market squid, and smelts (Gearin et al. 1994).

*OCCURRENCE OF HARBOR PORPOISE AT THE LWI PROJECT SITES*

Harbor porpoise have not been detected at the LWI project sites.

*OCCURRENCE OF HARBOR PORPOISE AT THE SPE PROJECT SITE*

Harbor porpoise have not been detected at the SPE project site.

TRANSIENT KILLER WHALE

*SPECIES RANGE*

The geographical range of the West Coast stock of transient killer whales includes the northeast Pacific from California to southeastern Alaska (Allen and Angliss 2014). This stock spends most of its time along the outer coast, but they also enter inside marine waters of Washington and British Columbia. Transient killer whale occurrences in inside marine waters have increased between 1987 and 2010, possibly because the abundance of some prey species (seals, sea lions, and porpoises) has increased (Houghton et al. 2015). Transient killer whales were observed in Hood Canal in 2003 and 2005, but prior to these occurrences, transients were rarely seen in Hood Canal. The 2003 occurrence consisted of 11 killer whales seen for 59 days between January and March, and the 2005 event consisted of 6 killer whales seen for 172 days between January and June (London 2006).

*POPULATION SIZE*

Preliminary analysis of photographic data has identified 521 individual transient killer whales in the West Coast stock (Allen and Angliss 2014). However, the subpopulation most likely to occur in the inside waters of southeastern Alaska, British Columbia, and Washington is smaller. A mark-recapture estimates the West Coast stock in 2006 that excluded a poorly known "outer coast" subpopulation and whales from California is 243 individuals (95 percent probability interval = 180–339) (Allen and Angliss 2014). The number in Washington waters at any given time is probably fewer than 20 individuals (Wiles 2004).

*BEHAVIOR AND ECOLOGY*

Transient killer whales feed on marine mammals and some seabirds, but they apparently do not consume fish, unlike Southern Resident killer whales (Morton 1990; Baird and Dill 1996; Ford et al. 1998, 2005; Ford and Ellis 1999). While present in Hood Canal, transient killer whales prey on harbor seals in the subtidal zone of the nearshore marine and marine deeper water habitats (London 2006). Other observations of foraging transient killer whales indicate that they prefer to forage for pinnipeds in shallow, protected waters (Heimlich-Boran 1988; Saulitis et al. 2000).

*OCCURRENCE OF TRANSIENT KILLER WHALE AT THE LWI PROJECT SITES*

Transient killer whales have not been detected at the LWI project sites.

*OCCURRENCE OF TRANSIENT KILLER WHALE AT THE SPE PROJECT SITE*

Transient killer whales have not been detected at the SPE project site.

3.4.1.2. HEARING AND UNDERWATER SOUND

Marine mammals produce sounds that are linked to their peak hearing capabilities in order to interact with one another, but their hearing sensitivity extends beyond that peak range to allow them to detect acoustic cues from their environment (Ketten 2004). They use sound to navigate in limited visibility conditions, detect prey, and detect and respond to predators. Manmade sound in the marine environment that is in excess of certain levels can affect marine mammals behaviorally and physiologically. Measurements of marine mammal vocalizations and hearing capabilities provide some basis for assessing whether exposure to a particular sound source may impact the ability of these species to function in their environment. Specifically, noise level (dB) and frequency (Hz) can affect the susceptibility of marine mammals to underwater sound. Sound frequency bands relevant to marine mammal species are based on measured or estimated hearing ranges (Southall et al. 2007) as well as vocalizations. The following sections summarize information available for the species that have been identified as occurring in Hood Canal.

#### 3.4.1.2.1. MARINE MAMMAL VOCALIZATIONS AND HEARING

Table 3.4–4 summarizes sound production and hearing capabilities for marine mammal species in the project area. The estimated auditory bandwidth is the lower to upper frequency hearing cut-off. The bandwidth of best hearing sensitivity is the portion of this range with lowest hearing thresholds measured in laboratory studies. Direct measurement of hearing sensitivity under laboratory conditions exists for approximately 20 of the nearly 130 species of marine mammals (Southall et al. 2007), including smaller toothed whales such as dolphins and porpoises, killer whales, and pinnipeds. Hearing sensitivity of larger whales has been modeled based on ear anatomy obtained from stranded animals or inferred from vocalizations and responses to sound in their environment (Ketten 1998; Parks et al. 2007). Species differ in absolute sensitivity and the frequency range of best hearing sensitivity. In general, marine mammals are arranged into the following functional hearing groups based on their generalized hearing sensitivities: high-, mid- and low-frequency cetaceans, phocid pinnipeds (true seals), and otariid pinnipeds (sea lions and fur seals) (Southall et al. 2007; NOAA 2015).

##### PINNIPEDS

Pinnipeds are amphibious, meaning that all foraging activity takes place in the water, but offspring are born on land at coastal rookeries (Mulsow and Reichmuth 2008). Thus, underwater and in-air frequency ranges for hearing and vocalizations are relevant to these species. On land, territorial male Steller sea lions regularly use loud, relatively low-frequency calls/roars to establish breeding territories (Schusterman et al. 1970; Loughlin et al. 1987). Individually distinct vocalizations exchanged between mothers and pups are thought to be the main way in which mothers reunite with their pups after returning to crowded rookeries following foraging at sea (Mulsow and Reichmuth 2008). On land, California sea lions make raucous barking sounds, with most of the sound energy occurring at less than 2 kilohertz (kHz) (Schusterman 1974). As amphibious mammals, pinniped hearing differs in air and in water (Kastak and Schusterman 1998), and separate auditory ranges have been measured in each medium. Phocid species have demonstrated an extended underwater frequency range of hearing, especially in the higher frequencies (Hemilä et al. 2006; Kastelein et al. 2009; Reichmuth et al. 2013), compared to the otariid species. Phocid ears have anatomical features that appear to adapt them better to hearing underwater than otariids (Hemilä et al. 2006). Harbor seals hear almost equally as well in air as underwater and have lower underwater sound detection thresholds at lower frequencies (below 64 kHz) than California sea lions (Kastak and Schusterman 1998). This difference is thought to make harbor seals more vulnerable to low-frequency manmade sounds such as ships and oil platforms.

**Table 3.4–4. Hearing and Vocalization Ranges for Marine Mammal Functional Hearing Groups and Species Potentially within the Project Area**

| Functional Hearing Group[1] | Functional Hearing Group – Estimated Auditory Bandwidth[1] | Species Represented in Project Area | Vocalization Dominant Frequencies (citation) | Best Hearing Sensitivity Range (citation) |
|---|---|---|---|---|
| **High-Frequency Cetaceans** | 200 Hz to 180 kHz[1] | Harbor Porpoise | 120 to 140 kHz (pulses; Tyack and Clark 2000; Hansen et al. 2008);<br>110 to 150 kHz (Ketten 1998) | 16 to 140 kHz (bimodal; reduced sensitivity at 64 kHz; maximum sensitivity 100 to 140 kHz; Kastelein et al. 2002) |
| **Mid-Frequency Cetaceans** | 150Hz to 160 kHz[1] | Killer Whale | 1.5 to 6 kHz (pulses; Richardson et al. 1995)<br>35 to 50 kHz (echolocation; Au et al. 2004)<br>6 to 12 kHz (whistles; Richardson et al.1995) | 18 to 42 kHz<br>(Szymanski et al. 1999) |
| **Low-Frequency Cetaceans** | 7 Hz to 25 kHz[2,3] | Humpback Whale | 200 Hz to 24 kHz (Au et al. 2006) | |
| **Phocid Pinnipeds (true seals)** | In-water: 75 Hz to 100 kHz[2]<br>In-air: 75 Hz to 30 kHz | Harbor Seal | In-water: 250 Hz to 4 kHz (males-grunts, growls, roars; Hanggi and Schusterman 1994)<br>In-air: 100 Hz to 1 kHz (males-snorts, grunts, growls; Richardson et al. 1995) | In-water: 1 to 50 kHz (Southall et al. 2007)<br>In-air: 6 to 16 kHz (Richardson et al. 1995; Wolski et al. 2003) |
| **Otariid Pinnipeds (sea lions)** | In-water: 100 Hz to 48 kHz[2]<br>In-air: 50 Hz to 75 kHz[4] | Steller Sea Lion | In-water: <1 kHz (male-pulses; Schusterman et al. 1970)<br>In-air: 150 Hz to 1 kHz (females; Campbell et al. 2002) | In-water: 1 to 16 kHz (male; Kastelein et al. 2005)<br>16 to 25 kHz (female; Kastelein et al. 2005)<br>In-air: 5 to 14 kHz (Schusterman 1974; Mulsow & Reichmuth 2008; Mulsow & Reichmuth 2010) |
| | | California Sea Lion | In-water: 500 Hz to 4 kHz (clicks, pulses, and barks; Schusterman et al. 1966, 1967; Schusterman & Balliet 1969)<br>In-air: 250 to 5 kHz (barks; Schusterman 1974) | In-water: 1 to 28 kHz (Schusterman et al. 1972)<br>In-air: 4 to 16 kHz (Mulsow et al. 2011a,b) |

Hz = Hertz; kHz = kilohertz

1. Source: Southall et al. 2007
2. Source: NOAA 2015.
3. Estimated hearing range for low-frequency cetaceans is based on behavioral studies, recorded vocalizations, and inner ear morphology measurements. No direct measurements of hearing ability have been successfully completed.
4. Source: Mulsow and Reichmuth 2010

KILLER WHALE

Killer whales produce several types of underwater sounds, including: (1) clicks used for echolocation, (2) highly variable whistles produced while whales socialize, and (3) pulsed signals generated at high repetition rates (Ford 1987). Both behavioral and auditory brainstem response measurements indicate they can hear in a frequency range of 1 to 100 kHz and are most sensitive at 20 kHz. This is one of the lowest maximum-sensitivity frequencies known among toothed whales (Szymanski et al. 1999).

Killer whales are "mid-frequency" cetaceans; that is, their echolocation signals use a frequency range that is somewhat lower than some of the other toothed whales, such as harbor porpoise. Social signals generally involve a lower frequency range. The most abundant and characteristic sound type produced by killer whales is pulsed signals, which are highly repetitive and fall into distinctive structural categories (Ford 1987). These are referred to as discrete calls, and one of their potential functions may be to help whales maintain contact while they are out of sight of each other (Ford and Ellis 1999).

The discrete call repertoire of Pacific Northwest transients is smaller than that of resident whales, with only four to six calls, none of which is used by resident whales. Moreover, transients are far quieter than residents when foraging, suggesting that transients must remain relatively silent to avoid alerting their prey because marine mammals such as pinnipeds are highly sensitive to sounds in the frequency range of sonar clicks (Barrett-Lennard et al. 1996).

HARBOR PORPOISE

The harbor porpoise is a "high-frequency" cetacean, meaning that the species uses high-frequency sounds for echolocation and lower frequency signals for social interactions (Southall et al. 2007). Its auditory range includes very high frequencies (estimated auditory bandwidth for the high-frequency category is 200 Hz to 180 kHz) (Southall et al. 2007).

3.4.1.2.2. SUSCEPTIBILITY OF MARINE MAMMALS TO UNDERWATER SOUND

PHYSIOLOGICAL IMPACTS OF SOUND

Marine mammals are susceptible to physiological impacts from noise exposure including temporary or permanent loss of hearing sensitivity or other physical injuries (Ketten 1995, 2000, 2004; Wartzok and Ketten 1999). Injury could consist of permanent hearing loss, referred to as permanent threshold shift (PTS), or other tissue damage. This type of injury has not been documented for pile driving or other construction-related noises because it is not feasible to measure pre- and post-exposure audiograms of individuals at construction sites. Temporary loss of hearing sensitivity, referred to as temporary threshold shift (TTS), has been documented in controlled settings using captive marine mammals exposed to strong sound exposure levels at various frequencies (Ridgway et al. 1997; Kastak et al. 1999; Finneran et al. 2005), but it has not been documented in wild marine mammals exposed to pile driving. TTS is an undesirable outcome of noise exposure because it can potentially affect communication and/or the ability to detect predators or prey.

BEHAVIORAL RESPONSES TO SOUND

Behavioral responses to sound are highly variable and context specific. For each potential behavioral change, the magnitude of the change ultimately determines the severity of the response. A number of factors may influence an animal's response to noise, including its previous experience; auditory sensitivity; biological and social status, including age and sex and behavioral state and activity at the time of exposure. Characteristics of the noise, such as duration and whether the sounds start suddenly or gradually, play a role in determining the animal's response. Indicators of disturbance may include sudden changes in the animal's behavior or avoidance of the affected area. A marine mammal may show signs that it is startled by the noise and/or it may swim away from the sound source and avoid the area. Behavioral changes such as increased swimming speed, increased surfacing time, and cessation of foraging in the affected area would indicate disturbance or discomfort.

Controlled experiments with captive marine mammals showed pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway et al. 1997; Finneran et al. 2003). Observed responses of wild marine mammals to loud sound sources (typically seismic guns or acoustic harassment devices) have been varied, but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds 2002; also see reviews in Gordon et al. 2004; Wartzok et al. 2003/2004; and Nowacek et al. 2007). However, some studies of acoustic harassment and acoustic deterrence devices have found habituation in resident populations of seals and harbor porpoises (see review in Southall et al. 2007; Blackwell et al. 2004).

Studies of marine mammal responses to continuous noise, such as vibratory pile installation, are limited. Marine mammal observers did not detect adverse reactions to the Test Pile Program (TPP) project or to the first year of EHW-2 construction at NAVBASE Kitsap Bangor (HDR 2012; Hart Crowser 2013b). During the TPP project, pinnipeds were more likely to dive and sink when closer to pile driving activity, and a greater variety of other behaviors were observed with increasing distance from pile driving (HDR 2012). Harbor seals observed during the EHW-2 project were equally likely to swim, dive, or sink as their ultimate behavior if they were inside the buffer zone and most likely to dive if they were outside the Waterfront Restricted Area (WRA) (Hart Crowser 2013b). Relatively few observations of cetacean behaviors were obtained during pile driving for both projects, and all were outside the WRA. Most harbor porpoises were observed swimming or traveling through the project area and no obvious behavioral changes were associated with pile driving.

A comprehensive review by Nowacek et al. (2007) of acoustic and behavioral responses to noise exposure concluded that displacement is one of the most common behavioral responses. To assess the significance of displacements, it is necessary to know the areas to which the animals relocate, the quality of that habitat, and the duration of the displacement in the event that they return to the pre-disturbance area. Short-term displacement may not be of great concern unless the disturbance happens repeatedly. Similarly, long-term displacement may not be of concern if adequate replacement habitat is available.

### 3.4.1.2.3. SUSCEPTIBILITY OF MARINE MAMMALS TO AIRBORNE SOUND

Exposure to airborne sound is primarily a concern for pinnipeds that are hauled out or swimming or resting with their ears out of the water. Airborne sound does not readily penetrate the air/water interface (Richardson et al. 1995) and is less significant for cetaceans. In general, pinnipeds are less sensitive to airborne sound than are most terrestrial carnivores and less sensitive to underwater sound than strictly aquatic mammals (e.g., cetaceans), within the range of best sensitivity (Kastak and Schusterman 1998). Pinniped hearing represents a compromise between aerial and aquatic adaptations, but the extent of adaptation for underwater hearing varies among pinniped families. California sea lions (members of the Otariidae, or eared seal family) appear to be better adapted to in-air hearing than underwater hearing, in comparison to harbor seals (members of the Phocidae, or hair seal family) which are better adapted to hearing underwater (Richardson et al. 1995; Kastak and Schusterman 1998). Within the range 100 Hz to 1.6 kHz, harbor seals hear nearly as well in air as underwater and have lower thresholds (i.e., greater sensitivity) than California sea lions (Kastak and Schusterman 1998). In air, harbor seals are most sensitive to frequencies between 6 and 16 kHz (Richardson et al. 1995; Terhune and Turnbull 1995; Wolski et al. 2003), but have functional hearing between 100 Hz and 30 kHz (Richardson et al. 1995; Kastak and Schusterman 1998). Thus, construction noise such as pile driving is well within the low-frequency range for this species. California sea lions are most sensitive at frequencies between 2 and 16 kHz (Schusterman 1974), and thus have functional hearing that includes lower-frequency construction noise (Kastak and Schusterman 1998).

A general discussion of behavioral responses to noise is provided in Section 3.4.1.2.2. Monitoring studies of hauled-out marine mammals near construction sites have generally reported negative results with respect to airborne sound (i.e., no apparent behavioral harassment), possibly because of habituation and the distances between the construction and the haul-out sites. Blackwell et al. (2004) reported that ringed seals hauled out as close as 1,640 feet (500 meters) to pile driving showed no adverse reaction. The marine mammal monitoring reports for the San Francisco–Oakland Bay Bridge East Span Seismic Safety Project (CALTRANS 2001, 2006, 2010) indicated that pile driving noise at the Yerba Buena Island harbor seal haul-out site, located from 2,953 feet (900 meters) to 4,920 feet (1,500 meters) from the pile driving barges, did not appear to elicit reactions from the seals.

### 3.4.1.3. CURRENT REQUIREMENTS AND PRACTICES

*ENDANGERED SPECIES ACT*

The ESA (16 USC 1531 et seq.) protects fish, wildlife, and plant species that are listed as threatened or endangered in the United States or elsewhere. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking or approving actions that may jeopardize listed species. The ESA also protects the designated critical habitat of listed species from adverse modification or destruction. NMFS is authorized to oversee compliance with the ESA for federally listed marine mammals. The LWI and SPE projects could indirectly affect humpback whales and Southern Resident killer whales because of effects on their prey base. The Navy prepared a biological assessment and requested informal consultation with NMFS (West Coast Region Office) regarding humpback whales and Southern resident killer whales under the ESA because the preferred alternative would not be likely to affect these listed species. As part of informal consultation, NMFS issued a Letter of Concurrence with this finding for the LWI project and requested formal ESA consultation for the SPE project (for potential effects on ESA-listed fish species).

*MARINE MAMMAL PROTECTION ACT*

The Marine Mammal Protection Act (MMPA) (16 USC 1361 et seq., as amended) places a moratorium on the taking and importation of all marine mammal species in the project area, with provisions for allowing incidental take and other regulated takings. NMFSHQ administers the MMPA for all 10 of the species of cetaceans, seals, and sea lions that occur in the vicinity of the LWI and SPE project sites. An Incidental Harassment Authorization (IHA) or Letter of Authorization (LOA) may be issued for projects involving taking of marine mammals due to harassment. Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment) (50 CFR, Part 216 Subpart A, Section 216.3-Definitions). The Navy has submitted an IHA application to NMFS HQ for Level B harassment due to construction of the SPE. The Navy did not request an IHA for construction of the LWI preferred alternative because it does not entail in-water pile driving and is not expected to result in harassment of marine mammals as defined by the MMPA.

*Underwater Sound Injury and Behavioral Harassment Thresholds*

Since 1997, NMFS has used generic sound exposure thresholds to determine when an activity in the ocean that produces sound might harm a marine mammal (70 FR 1871). These thresholds are used to determine compliance with the MMPA (16 USC 1362 Sec. 3 (13)) and the ESA (16 USC 1531 et seq.), although the effects determinations and language used to report exposure to harmful noise levels are different for the two statutes. The MMPA imposes a moratorium on the taking of marine mammals, where "take" means to harass, among other actions. The MMPA defines two levels of harassment, each of which has been assigned a noise exposure threshold. Injury-level thresholds apply in situations where the noise "has the potential to injure a marine mammal or marine mammal stock in the wild" (Level A harassment) (16 USC 1362 Sec. 3 (18)(A)(i)). Behavioral disturbance (harassment) thresholds are applied in situations where the noise "has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering" (Level B harassment) (16 USC 1362 Sec. 3 (18)(A)(ii)). The Navy submitted an application for an IHA for SPE in November 2014, updated in June 2015, from NMFSHQ under the MMPA [Sec. 101(a)(5)(D)], listing the estimated number of marine mammals exposed to harassment incidental to construction of the project.

*Airborne Sound Behavioral Harassment Thresholds*

As described above for *Underwater Sound Injury and Behavioral Harassment Thresholds*, NMFS has used generic sound exposure thresholds to determine when an activity in the ocean that produces sound might result in impacts such as injury to a marine mammal (70 FR 1871). NMFS has identified behavioral harassment threshold criteria for airborne noise generated by pile driving for pinnipeds regulated under the MMPA. Injury threshold criteria for airborne noise have not been established. The behavioral harassment threshold for harbor seals is 90 dB RMS (unweighted) and for all other pinnipeds is 100 dB RMS (unweighted).

## 3.4.2. Environmental Consequences

### 3.4.2.1. APPROACH TO ANALYSIS

The evaluation of impacts on marine mammals considers the importance of the resource (i.e., legal, recreational, ecological, or scientific); the proportion of the resource affected relative to its occurrence in the region; the particular sensitivity of the resource to project activities; and the duration of environmental impacts or disruption. Impacts on resources would be critical if any of the following conditions apply:

- Habitats of high concern are adversely affected over relatively large areas;
- Disturbances to small, essential habitats would lead to regional impacts on a protected species; or
- Disturbances harass or impact the ability of species to acquire resources and ultimately impact the abundance or distribution of federally listed threatened or endangered species.

The analysis of impacts on marine mammals addresses construction and operational impacts on behavior, habitat, movement, and prey base for the eight species described in Section 3.4.1.1. Direct effects causing behavioral disturbance or injury and effects of permanent habitat loss are concerns, as is continued or progressive habitat degradation.

The primary impacts on marine mammals from construction of the LWI and SPE would be associated with water quality changes (turbidity) in nearshore habitats, noise associated with impact and vibratory pile driving, construction vessel traffic, and changes in prey availability. In particular, underwater pile driving noise during the construction period has the potential to disrupt marine mammal foraging, resting, and transit in the vicinity of the LWI and SPE project sites. The zones of impact due to construction noise are described in following sections. Pile driving would exceed some of the underwater noise thresholds for marine mammals established by NMFS for behavioral harassment and injury, and result in the greatest potential for adverse impacts on marine mammals. Construction impacts on marine mammals are anticipated to be temporary and highly localized to the construction area, as discussed below in detail for each project alternative, with the exception of impacts due to vibratory pile driving noise, which would extend over a large area as described in Sections 3.4.2 and 3.4.3.

Long-term operation of the LWI and SPE would include the presence of in-water barriers in areas that currently do not have in-water barriers. Marine mammals are highly mobile and would be able to swim around the nearshore (LWI) barriers and the deeper water SPE. However, these barriers may affect the migratory pathways and distribution of some fish populations that are preyed upon by marine mammals, as described in Section 3.3.2.2.

### 3.4.2.2. LWI PROJECT ALTERNATIVES

#### 3.4.2.2.1. LWI ALTERNATIVE 1: NO ACTION

There would be no activities related to construction or operations that would disturb marine mammals in the project area under the No Action Alternative. Therefore, this alternative would have no impacts on marine mammals.

#### 3.4.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

Construction of the LWI would directly impact marine mammals primarily through underwater noise generated by pile driving. Underwater noise thresholds for behavioral disturbance would be exceeded, as described below, with potential adverse impacts (takes) as defined by the MMPA. Project-related changes in water quality, vessel traffic, and prey availability may also affect marine mammals indirectly or directly.

Long-term indirect impacts would result from localized changes in benthic prey population composition (Section 3.2) and marine fish populations (Section 3.3). The primary impacts on marine fish from operation of LWI Alternative 2 would include an increase of physical barriers in the nearshore environment, alteration of nearshore habitats including some reduction in natural refugia, some reduction in prey availability, a potential reduction in the forage fish community, and a decrease in nearshore aquatic vegetation.

Impacts on marine mammals from operation of this alternative are anticipated to be highly localized because marine mammals are wide-ranging and have a large foraging habitat available in Hood Canal, relative to the foraging area that might be impacted by operation of the LWI.

##### CONSTRUCTION OF LWI ALTERNATIVE 2

The primary impacts on marine mammals from construction of the LWI would be associated with water quality changes (turbidity) in nearshore habitats, noise associated with impact and vibratory pile driving and other construction equipment, construction vessel traffic, and changes in prey availability. Since harbor seals are resident in Hood Canal, they would be present during the entire proposed construction season for the LWI (August 2016 through January 15, 2017). California sea lions, harbor porpoises and transient killer whales also may occur at any time during the year. Steller sea lions are present during fall and winter months (about 4 months out of the 6 months of in-water construction work). Marine mammals are likely to avoid (indicating behavioral disturbance) the vicinity of pile driving. The likelihood of adverse impacts on these species would be minimized through application of mitigation measures described in the Mitigation Action Plan (Appendix C).

The following sections describe how each of these factors would impact abundance and distribution of marine mammals present or potentially present on NAVBASE Kitsap Bangor during construction.

*WATER QUALITY*

Construction of the LWI would affect water quality in the project area due to installation of piles and steel plate anchors for the mesh barrier, anchoring of barges and tugs, relocation of PSB buoys, and work vessel movements, as discussed in Section 3.1.2.2.2. Water quality would be impacted during tug and barge operations and installation of piles, because bottom sediments would be temporarily resuspended and spread up to approximately 100 feet (30 meters). A maximum of 13.1 acres (5.3 hectares) of benthic habitat may be temporarily disturbed within the construction footprint. Resuspended sediments would increase turbidity periodically during in-water construction activities, but turbidity is expected to be localized (within the 100-foot construction corridor) and temporary during the course of project construction. Metals and organic contaminants that may be present in sediments could also become suspended in the water column in the construction impact zone, but these contaminants are within sediment quality guidelines, as discussed in Section 3.1.1.1.3. Water quality could also be impacted by stormwater discharges (contaminant loading), and spills (contaminant releases). However, construction-period conditions are not expected to exceed water quality standards, and measures for the protection of marine water quality and the seafloor would be implemented to minimize impacts (Mitigation Action Plan, Appendix C). Marine mammals are expected to avoid the immediate construction area due to increased vessel traffic, noise and human activity, increased turbidity, and potential difficulty in finding prey. Because suspended sediment and contaminant concentrations would be low, and exposures would be localized, no impacts on marine mammals are expected due to changes in water quality during construction. Considering the wide distribution of marine mammals in inland marine waters, water quality changes due to LWI Alternative 2 would not significantly affect these populations or overall distribution.

*VESSEL TRAFFIC*

Vessel movements have the potential to affect marine mammals directly by accidentally striking or disturbing individual animals. For example, several studies have linked vessels with behavioral changes in killer whales in Pacific Northwest inside waters (Kruse 1991; Kriete 2002; Williams et al. 2002; Bain et al. 2006), although it is not well understood whether the presence and activity of the vessel, the vessel noise, or a combination of these factors produces the changes. It seems likely that both noise and visual presence of vessels play a role in prompting reactions from these animals. The probability and significance of vessel and marine mammal interactions is dependent on several factors including numbers, types, and speeds of vessels; the regularity, duration, and spatial extent of activities; and the presence/absence and density of marine mammals.

Behavioral changes in response to vessel presence include avoidance reactions, alarm/startle responses, temporary abandonment of haul-outs by pinnipeds, and other behavioral and stress-related changes (e.g., altered swimming speed, direction of travel, resting behavior, vocalizations, diving activity, and respiration rate) (Watkins 1986; Würsig et al. 1998; Terhune and Verboom 1999; Ng and Leung 2003; Foote et al. 2004; Mocklin 2005; Bejder et al. 2006; Nowacek et al. 2007). In other cases neutral behavior (i.e., no obvious avoidance or attraction) has been reported (review in Nowacek et al. 2007). Little is known about the biological importance of changes in marine mammal behavior under prolonged or repeated exposure to high levels of vessel traffic, such as increased energetic expenditure or chronic stress, which can produce adverse hormonal or nervous system effects (Reeder and Kramer 2005).

Marine mammals on NAVBASE Kitsap Bangor encounter vessel traffic associated with daily operations, maintenance, and security monitoring along the waterfront, and it is assumed that individuals frequenting the waterfront have habituated to existing levels of vessel activity. During construction of the LWI, several additional vessels would operate in the project area, including one barge with a crane, one supply barge, a tug boat, and work skiffs. Construction activity involving vessel traffic may occur over 24 months, but the greatest activity levels would be associated with pile driving (up to 80 days during one in-water work season). Approximately 16 total transits of barges and tugs are expected for the duration of the project (Table 2–1). These vessels would operate at low speeds within the relatively limited construction zone and access routes during the in-water construction period. Low speeds are expected to reduce the impact of boat movements in the construction zone during this period. Marine vessel traffic would potentially pass near marine mammals on an incidental basis, but short-term behavioral reactions to vessels are not expected to result in long-term impacts on individuals, such as chronic stress, or to marine mammal populations in Hood Canal.

Collisions of vessels and marine mammals, primarily cetaceans, are not expected during construction because vessel speeds would be low. All of the cetaceans likely to be present in the project area are fast-moving odontocete species that tend to surface at relatively short, regular intervals allowing for increased detectability and avoidance of vessels. Vessel impacts are more frequently documented in relation to slower-moving cetaceans or those that spend extended periods of time at the surface, but these species are rarely encountered in Hood Canal.

*PREY AVAILABILITY*

The prey base for the most common marine mammal species (harbor seal and California sea lion) in the project area potentially includes a wide variety of fishes including Pacific hake, forage fish such as Pacific herring, adult and juvenile salmonids, flatfish, and other finfish. Steller sea lions in the project area probably also consume a variety of pelagic and bottom fish. Harbor porpoise are also occasionally seen in Hood Canal, where they probably feed on schooling forage fishes, such as Pacific herring, smelt, and squid. Transient killer whales consume marine mammals; in Hood Canal they preyed on harbor seals during prolonged stays in 2003 and 2005 (London 2006). Southern Resident killer whales do not occur in Hood Canal, but consume adult salmonids (with strong preferences for Chinook salmon and chum salmon [Hanson et al 2010a,b]) that may originate in Hood Canal tributaries.

As described in Section 3.3.1.1, fish species and groups that occur in the LWI project area include forage fish (Pacific sand lance, surf smelt, Pacific herring) and salmonids (yearling Chinook salmon, coho salmon, and steelhead; summer-run chum salmon; and cutthroat trout) (Bhuthimethee et al. 2009). As described in Section 3.2.1.1, a number of benthic invertebrate species are abundant and diverse at both LWI project sites. These nearshore resources offer suitable prey for some of the marine mammals that have been documented in Hood Canal and the Bangor waterfront, but available information is not sufficiently detailed to support a comparison of these sites with other known or potential foraging sites in inland waters.

Impacts on prey availability for fish-eating marine mammals due to construction activities are discussed in detail for marine fish (Section 3.3.2.2.2). Some of the prey species, including forage fish and juvenile salmonids are considered more vulnerable to project impacts than deeper-water species such as adult salmonids and Pacific hake. The greatest impacts on prey species during construction would result from nearshore benthic habitat displacement and degradation (13.1 acres [5.3 hectares]) (Table 3.2-8), resuspension of sediments, localized turbidity, physical barriers to fish migration in nearshore waters, and behavioral disturbance due to pile driving noise. Anchoring of construction barges, propeller wash, pile driving, mesh installation, and installation of anchor plates would locally displace or disturb nearshore benthic habitats and increase turbidity, while the presence of barges and construction of decking would shade benthic habitat and marine vegetation in the immediate project vicinity. All of these actions would indirectly affect marine mammals by degrading foraging and refuge habitat quality for prey species, and thereby reducing their availability to predators. Mitigation efforts, including scheduling in-water pile driving for the period when most juvenile Chinook and chum salmon are not present, as described in Section 3.3.2.2.2, and protection of water and seafloor quality, as described in Section 3.1.1.2.3, would minimize these potential adverse effects on the prey base.

Injury and behavioral disturbance of fish species due to underwater pile driving noise would directly affect the prey base for marine mammals. Fish potentially would be disturbed by pile driving noise resulting from operation of vibratory and impact rigs within 7,068 feet (2,154 meters) of impact pile driving noise and 178 feet (54 meters) of vibratory pile installation (Section 3.3.2.2.2) but may actually avoid a much smaller area. Thus, prey availability within an undetermined portion of the impact zone for fish would be reduced during construction due to noise. Mitigation measures designed to minimize noise effects on fish are described in the Mitigation Action Plan (Appendix C).

Some of the effects described above, such as barge placement, increased turbidity, and pile driving noise, would occur only during the in-water construction period and thus would be temporary (up to 6 months in each of two in-water work seasons), and localized within the fish behavioral disturbance zone. Mesh installation and relocation of PSBs and anchors could occur for up to 24 months. Long-term effects on prey availability are described below under Operation/Long-term Impacts. While effects of project construction may affect the prey base of pinnipeds that occur in the immediate project vicinity, in the overall context of the Hood Canal harbor seal and California sea lion population ranges the affected area is too small to represent a significant adverse impact on population numbers and distribution.

With respect to the ESA-listed Southern Resident killer whale, the project has the potential to affect this population by indirectly affecting its prey base, which includes a disproportionate number of adult Chinook and chum salmon (Ford et al. 1998, 2010; Hanson et al. 2010a,b). Available information on the proportion of Hood Canal Chinook salmon in the diet of Southern Resident killer whales indicates that it is about 20.4 percent in May (although this is based on a sample size of only nine), but it is less than 5 percent in other months (June to September) for which data are available. The stock identification of chum salmon in Southern Resident killer whale diets has not been reported and therefore the importance of Hood Canal chum salmon is not known. Adult Hood Canal Chinook and chum salmon returns are subject to many variables, among which the effects of LWI are likely to be minor. Mitigation efforts, including scheduling in-water construction for the period when juvenile Chinook and chum salmon are not present and using a bubble curtain for impact pile driving would minimize this potential adverse effect. Alternative 2 may indirectly affect Southern Resident killer whales through their prey populations, but the project's effect on the species' prey base would be minimal. Therefore, the ESA effect determination for construction activities under LWI Alternative 2 is "may affect, not likely to adversely affect" Southern Resident killer whales. The project would have no effect on critical habitat for Southern Resident killer whales because no critical habitat has been designated in Hood Canal.

*UNDERWATER NOISE*

Average underwater noise levels measured along the Bangor waterfront are elevated over ambient conditions at undeveloped sites due to waterfront operations, but are within the minimum and maximum range of measurements taken at similar environments within Puget Sound (see Appendix D). In 2009, the average broadband ambient underwater noise levels were measured at 114 dB re 1 μPa between 100 Hz and 20 kHz (Slater 2009). Peak spectral noise from industrial activity was noted below the 300 Hz frequency, with maximum levels of 110 dB re 1 μPa noted in the 125 Hz band. In the 300 Hz to 5 kHz range, average levels ranged between 83 and 99 dB re 1 μPa. Wind-driven wave noise dominated the background noise environment at approximately 5 kHz and above, and ambient noise levels flattened above 10 kHz. Underwater ambient noise measurements taken at EHW-1 (approximately 1,500 feet [450 meters] from the north LWI and 5,900 feet [1,800 meters] from the south LWI) during the TPP project in 2011, ranged from 112.4 dB re 1 μPa RMS between 50 Hz and 20 kHz at mid depth to 114.3 dB at deep depth (Illingworth & Rodkin 2012).

Increased vessel activity and barge-mounted construction equipment such as cranes and generators would elevate underwater noise levels in the project. Noise from tugs associated with barge movement would produce intermittent noise levels of approximately 142 dB re 1 μPa at 33 feet (10 meters). Except at very close range, these noise sources and noise from other vessels and equipment would not exceed the marine mammal thresholds for disturbance due to impact sound (160 dB RMS). These noise levels are typical of an industrial waterfront where tugs, barges, and other vessels are in operation, and consistent with noise levels experienced daily by marine mammals under existing conditions in the vicinity of the Bangor waterfront. Vessel noise includes narrowband tones at specific frequencies and broadband sounds, with energy spread over a range of frequencies that are audible to marine mammals. Smaller vessels that would be used in construction tend to generate low-frequency noise below 5 kHz; for example, tugs operating barges generate sounds from 1 kHz to 5 kHz, and small crewboats generate strong tones up to several hundred hertz (Richardson et al. 1995).

Underwater noise associated with pile driving activities is likely to cause the most significant impacts on marine mammals present during construction of the LWI. Detailed analyses of pile driving noise propagation and pile driving source levels are presented in Appendices D and H, along with a discussion of the use of a bubble curtain to attenuate impact pile driving noise. The LWI north pier would require installation of up to 54 permanent hollow steel piles, 24 inches (60 centimeters) in diameter. The LWI south pier would require up to 82 piles of the same type. The abutment piles would be installed in the dry during low tides and would not generate underwater noise. Approximately 120 hollow, 24-inch steel piles would be installed temporarily during the construction phase and then would be removed. It is expected that up to four piles would be installed per day and the total number of pile driving days would be up to 80 days during a single in-water construction season that includes the period August through January 15. Most piles would be driven with a vibratory driver, and an impact hammer would be used to "proof" these piles. In cases where substrate conditions do not allow vibratory installation, an impact hammer may be needed to drive piles for part or all of their length.

Vibratory pile driving of 24-inch (60-centimeter) steel piles would produce noise levels of approximately 161 dB RMS re 1 µPa at 33 feet (10 meters) from the pile. As described in Appendix D, a bubble curtain would be used to reduce sound levels of impact pile driving of steel piles. Impact pile driving using a single-acting diesel impact hammer would produce average RMS noise levels of 185 dB RMS re 1 µPa at 33 feet while using a bubble curtain that reduces noise levels by 8 dB (Appendix H). Other mitigation measures include a soft-start approach for pile driving operations and marine mammal monitoring and shutdown zones during pile driving, as described in the Mitigation Action Plan (Appendix C). Most of the energy in pile driving sound underwater is contained in the frequency range 25 Hz and 1.6 kHz, with the highest energy densities between 50 and 350 Hz (Reyff et al. 2002). In some studies, underwater pile driving noise has been reported to range up to 10 kHz with peak amplitude below 600 Hz (Laughlin 2005).

Sound from impact pile driving would be detected above the average background noise levels at any location in Hood Canal with a direct acoustic path (i.e., line-of-sight from the driven pile to receiver location). Intervening land masses would block sound propagation outside of those paths.

*Responses to Underwater Pile Driving Noise at the LWI Project Sites*

Marine mammals encountering pile driving operations during the in-water construction season would likely avoid affected areas in which they experience noise-related discomfort, limiting their ability to forage or rest there. Individual responses to pile driving noise are expected to be variable; some individuals may occupy the project area during pile driving without apparent discomfort, but others may be displaced by undetermined long-term effects. Avoidance of the affected area during pile driving operations would reduce the likelihood of injury impacts but would reduce access to foraging areas in nearshore and deeper waters of Hood Canal. Noise-related disturbance across the 1.5-mile (2.4-kilometer) width of Hood Canal may inhibit some marine mammals from transiting the area. However, habituation may occur over time, along with a decrease in the severity of responses. Also, since pile driving would only occur during daylight hours, marine mammals transiting the project area or foraging or resting in the project area at night would not be affected. Any potential impacts from pile driving activities could be experienced by individual marine mammals, but would not cause population level impacts or affect the continued survival of the species.

*Underwater Injury and Behavioral Harassment Thresholds*

The following analysis of noise-related impacts on marine mammals provides calculations of incidental harassment exposures of all marine mammal species that occur in the LWI project area, as required by the MMPA. "Take" under the MMPA is calculated at two levels, injury exposure and behavioral harassment exposure, using the same threshold values for each level of noise exposure for each statute. The effects analysis uses the terms "injury exposure" and "behavioral harassment exposure" for MMPA effects and states the number of exposures that the Navy will request for each marine mammal species in its IHA application.

NMFS identified threshold criteria for determining injury exposure to underwater noise as 190 dB RMS re 1 µPa for pinnipeds and 180 dB RMS re 1 µPa for cetaceans (65 FR 16374-16379) (Table 3.4–5). Injury exposure criteria have been used by NMFS to define the impact zones for seismic surveys and impact hammer pile driving projects, within which project activities may be shut down if protected marine mammals are present (some examples are cited in 71 FR 4352, 71 FR 6041, 71 FR 3260, and 65 FR 16374). NMFS has identified different thresholds for exposure to behavioral harassment for impact pile driving (an impulsive noise impact) versus vibratory pile driving (a continuous noise impact). For both cetaceans and pinnipeds, the behavioral harassment threshold for impact pile driving is 160 dB RMS re 1 µPa, and the threshold for continuous noise such as vibratory pile driving is 120 dB RMS re 1 µPa.

NOAA (2015) updated draft acoustic threshold levels for determining the onset of PTS and TTS (permanent and temporary hearing threshold shifts) in marine mammals in response to underwater impulsive and non-impulsive sound sources. The draft criteria use cumulative SEL metrics (dB $SEL_{CUM}$) and peak pressure (dB peak) rather than the currently used dB RMS metric. NOAA equates the onset of PTS, which is a form of auditory injury, with Level A harassment under the MMPA and "harm" under the ESA. The onset of TTS would be a form of Level B harassment under the MMPA and "harassment" under the ESA. Both forms of harassment would constitute "take" under these statutes. The draft injury criteria are currently in public review and are expected to be finalized in late 2015. Revised behavioral harassment criteria not involving TTS (but resulting in Level B take) are currently in review. If the new injury criteria are adopted by NOAA prior to the completion of the Record of Decision (ROD) for the project, the noise effects analysis for marine mammals would be updated. Otherwise, the noise analysis would not be updated.

Under current underwater noise guidelines (Table 3.4–5) and with a properly functioning bubble curtain in place on the impact hammer rig, construction of the LWI pile-supported piers would likely result in noise-related injury to pinnipeds and cetaceans within 16 feet (5 meters) and 72 feet (22 meters) from a driven pile, respectively (Table 3.4–6). Injury exposure to intense underwater noise could consist of PTS or other tissue damage. However, marine mammals are unlikely to be injured by pile driving noise at these short distances because the high level of human activity and vessel traffic would cause avoidance of the immediate construction area. Cetaceans, in particular, are unlikely to swim this close to manmade structures. In addition, marine mammal monitoring and shutdown during construction (Mitigation Action Plan, Appendix C, Section 4.2) would prevent exposure to injury from pile driving noise.

**Table 3.4–5. Current Marine Mammal Injury and Behavioral Harassment Thresholds for Underwater and Airborne Sounds**

| Marine Mammals | Airborne Marine Construction Thresholds (Impact and Vibratory Pile Driving) (dB re 20 µPa unweighted) | Underwater Vibratory Pile Driving[2] Threshold (dB re 1 µPa) | | Underwater Impact Pile Driving[3] Thresholds (dB re 1 µPa) | |
|---|---|---|---|---|---|
| | Disturbance Guideline Threshold[1] | Injury Threshold | Behavioral Harassment Threshold | Injury Threshold | Behavioral Harassment Threshold |
| Cetaceans (whales, dolphins, porpoises) | N/A | 180 dB RMS | 120 dB RMS | 180 dB RMS | 160 dB RMS |
| Pinnipeds (seals, sea lions, except harbor seal) | 100 dB RMS | 190 dB RMS | 120 dB RMS | 190 dB RMS | 160 dB RMS |
| Harbor seal | 90 dB RMS | 190 dB RMS | 120 dB RMS | 190 dB RMS | 160 dB RMS |

dB = decibel; µPa = micropascal; N/A = not applicable, no established threshold; RMS = root mean square

1. Sound level at which pinniped haul-out disturbance has been documented. Not an official threshold, but used as a guideline.
2. Non-pulsed, continuous sound.
3. Impulsive sound.

**Table 3.4–6. Calculated Maximum Distance(s) to the Underwater Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Current Noise Thresholds, LWI Alternative 2**

| Affected Area | Impact Injury Pinnipeds (190 dB RMS)[1] | Impact Injury Cetaceans (180 dB RMS)[1] | Impact Behavioral Harassment Cetaceans & Pinnipeds (160 dB RMS)[1] | Vibratory Behavioral Harassment Cetaceans & Pinnipeds (120 dB RMS)[1, 2] |
|---|---|---|---|---|
| Distance to Threshold[1] | 16 ft (5 m) | 72 ft (22 m) | 1,522 ft (464 m) | 3.4 mi (5.4 km) |
| Area Encompassed by Threshold | 850 sq ft (79 sq m) | 16,372 sq ft (1,521 sq m) | 0.2 sq mi (0.5 sq km) | 11.0 sq mi (28.5 sq km) |

dB = decibel; ft = feet; km = kilometer; m = meter; mi = mile; sq ft = square feet; sq km = square kilometer; sq m = square meter; sq mi = square mile; µPa = micropascal; RMS = root mean square

1. Bubble curtain assumed to achieve 8 dB reduction in sound pressure levels (or SPLs) during impact pile driving. Sound pressure levels used for calculations were 185 dB re 1 µPa at 33 feet (10 meters) for impact hammer with bubble curtain and 161 dB re 1 µPa for vibratory driver for 24-inch (60-centimeter), hollow steel pile. All sound levels are expressed in dB RMS re 1 µPa.
2. Calculated area is greater than actual sound propagation through Hood Canal due to intervening land masses. Thus, 3.4 miles (5.4 kilometers) is the greatest line-of-sight distance from pile driving locations unimpeded by land masses that would block further propagation of sound.

No physiological impacts are expected from pile driving operations occurring during construction of the LWI for the following reasons. First, vibratory pile driving, which would be the primary installation method, does not generate high enough peak sound pressure levels (or SPLs) to produce physiological damage. Assuming 45 pile strikes per minute, 5,000 strikes could be accomplished in less than 2 hours per day. Thus, under the worst-case scenario, marine mammals in the vicinity of the LWI project sites would experience elevated noise levels for only a portion of the day. Additionally, the bubble curtains that the Navy would employ during impact pile driving (Appendix D) would greatly reduce the chance that a marine mammal may be exposed to sound pressure levels that could cause physical harm. During impact pile driving, the Navy would employ a bubble curtain to attenuate initial sound pressure level. Moreover, the Navy would have trained biologists monitoring a shutdown zone equivalent to the potential physiological injury zone (Mitigation Action Plan, Appendix C) to reduce the potential for injury of marine mammals.

The areas encompassed by these threshold distances are shown in Table 3.4–6 for the south LWI pier, representing the most conservative scenario for calculating above-threshold noise levels because it is a longer structure and is closer to the haul-out site for sea lions at Delta Pier. Table 3.4–6 is based on calculations of the areas affected by pile driving at a representative location at the end of the south LWI. Placement of pile driving rigs at other locations along the LWI alignments would generate above-threshold noise levels in slightly different areas. A representative scenario of areas affected by above-threshold noise levels is shown in Figure 3.4–1. Conservatively, the representative areas in Figure 3.4–1 depict effects related to operation of a pile driver at one location at the seaward end of the north and south LWI piers, but pile driving would occur along the entire length of both piers. Only one impact pile driver would operate at a time.

Behavioral disturbance due to impact pile driving is calculated at approximately 1,522 feet (464 meters) from the driven pile, resulting in an affected area of approximately 0.2 square mile (0.5 square kilometer) around the driven pile. Marine mammals within this area would be susceptible to behavioral harassment during impact pile driving operations. The calculated distance for the behavioral harassment threshold due to vibratory installation is approximately 3.4 miles (5.4 kilometers), but intervening land masses would truncate the propagation of underwater sound from the driven pile (Figure 3.4–1). The area encompassed by the truncated threshold distance is approximately 11.0 square miles (28.5 square kilometers) around the pile drivers (Figure 3.4–1). Marine mammals within this area would be susceptible to behavioral harassment due to vibratory pile driving operations.

As described in Section 3.4.1.2.2, behavioral responses of marine mammals to underwater noise are variable and context specific. Some individuals may habituate to the elevated construction noise levels and continue to use the affected area, while other animals may avoid the area or respond by modifying feeding or resting behaviors. Temporary loss of hearing sensitivity in marine mammals (TTS) is a possible outcome of exposure to intense underwater noise that would be considered a form of behavioral harassment, as TTS is considered to be physiological fatigue rather than injury (Popper et al. 2006). TTS is an undesirable outcome of noise exposure because it can potentially affect communication and/or the ability to detect predators or prey. Behavioral harassment can also be indicated by actions such as avoidance of the construction area, changes in travel patterns, diving behavior, respiration, or feeding behavior.

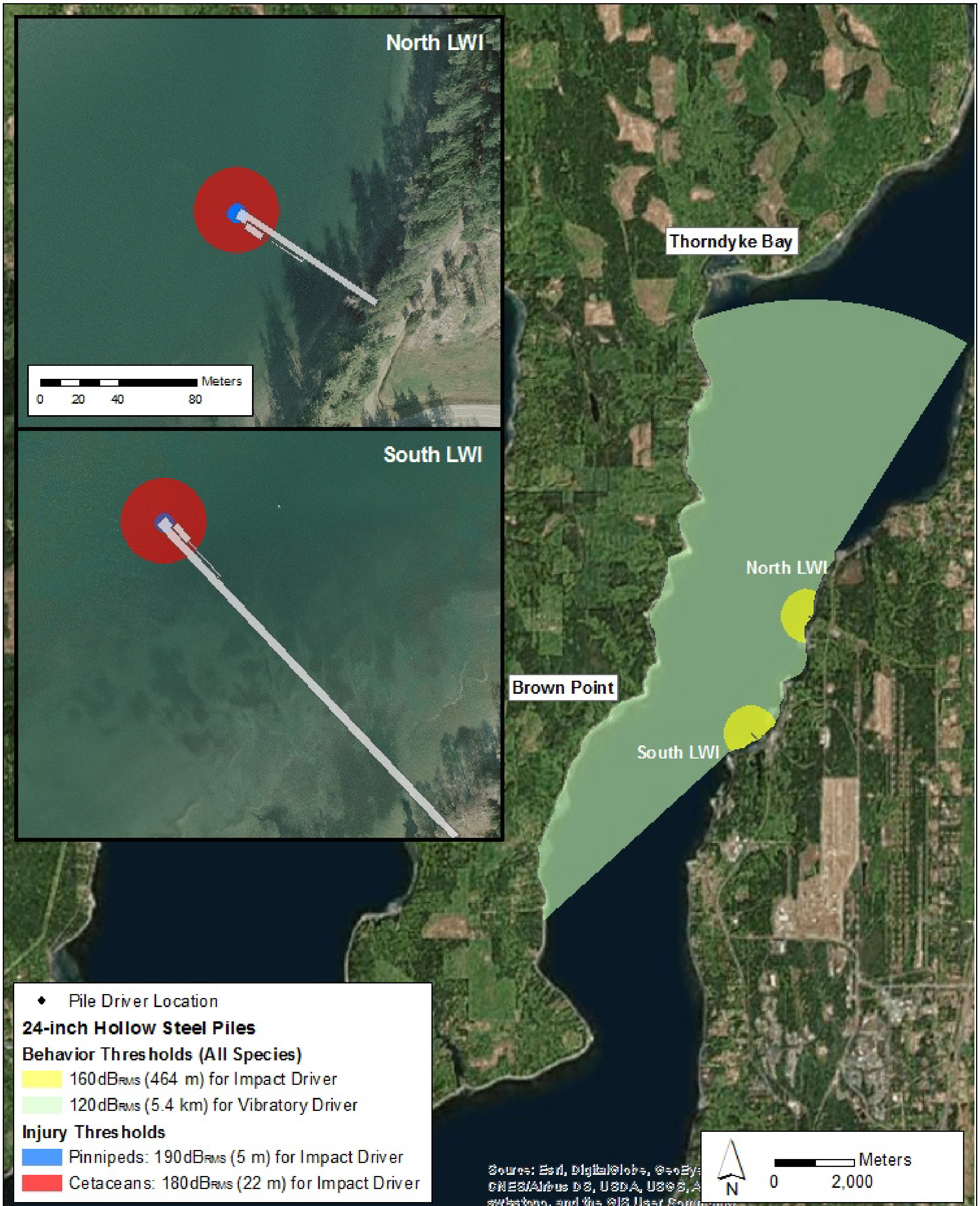


**Figure 3.4-1. Representative View of Affected Areas for Marine Mammals Due to Underwater Pile Driving Noise during Construction of LWI Alternative 2**

*AIRBORNE NOISE*

Construction of the LWI would result in increased airborne noise in the vicinity of the construction sites, as discussed in Section 3.9.3.2. The highest noise source levels would be associated with impact pile driving up to 54 24-inch (60-centimeter) steel piles in water at the north LWI project site and up to 82 piles in water at the south LWI project site, and 15 36-inch [90-centimeter]) steel piles driven in the dry at the north LWI site and 16 36-inch steel piles at the south site. Pile driving noise source levels are estimated to be 110 dB RMS maximum noise level (Lmax) re 20 µPa (unweighted) at 50 feet (15 meters) from the pile for an impact hammer, and 92 dB RMS equivalent sound level (Leq) re 20 µPa (unweighted) at 50 feet from the pile for vibratory pile driving (Section 3.9.3.2.2). The dominant airborne noise frequencies produced by pile driving would be between 50 and 1,000 Hz (Washington State Department of Transportation [WSDOT] 2013). Airborne noise would primarily be an issue for pinnipeds that are swimming or hauled out in the project area. Mitigation measures for pile driving noise, including a soft-start approach to pile driving and marine mammal monitoring, are described in the Mitigation Action Plan (Appendix C, Sections 3.2 and 4.2).

In addition to pile driving, other LWI construction activities and equipment would generate lower noise levels that are comparable to ambient levels elsewhere along the Bangor waterfront where ongoing operations use trucks, forklifts, cranes, and other equipment (Section 3.9.3.2). Construction equipment for the LWI project would include backhoes, bulldozers, loaders, graders, trucks, and cranes. Activities that would generate elevated noise levels could include excavation for the abutments; construction of the pier deck and fence, stairways, and road construction. Average noise levels are expected to be in the 60 to 68 A-weighted decibel (dBA) range, consistent with urbanized or industrial environments where equipment is operating and similar to the range of noise measured on Delta Pier (Navy 2010). Operation of non-pile driving, heavy construction equipment would produce airborne noise levels ranging from 78 to 90 dBA at 50 feet (15 meters) (WSDOT 2013). In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet (Section 3.9), but this noise level would be occasional.

*Responses to Airborne Pile Driving Noise at the LWI Project Sites*

Pinnipeds have habituated to existing airborne noise levels at Delta Pier on NAVBASE Kitsap Bangor, where they regularly haul out on submarines and the pontoons supporting the PSB. Most likely, airborne sound would cause behavioral responses similar to those discussed above in relation to underwater noise. For instance, elevated airborne construction noise could cause hauled out pinnipeds to return to the water, reduce vocalizations, or cause them to temporarily abandon their usual or preferred haul-out locations and move farther from the noise source. Pinnipeds swimming in the vicinity of pile driving may avoid or withdraw from the area or show increased alertness or alarm (e.g., head out of the water and looking around).

*Airborne Sound Behavioral Harassment Thresholds*

Pile driving can generate airborne noise that could potentially result in disturbance to marine mammals (pinnipeds) that are hauled out or at the water's surface. As result, the Navy analyzed the potential for pinnipeds hauled out or swimming at the surface near NAVBASE Kitsap Bangor to be exposed to airborne noise that could result in behavioral harassment, as defined by the MMPA. There are no criteria for injury due to elevated airborne sound. NMFS has defined the airborne noise threshold for behavioral harassment for all pinnipeds except harbor seals as 100 dB RMS re 20 µPa (unweighted) (Table 3.4–5). The threshold value for harbor seals is 90 dB RMS re 20 µPa (unweighted).

Impact pile driving noise for the LWI would likely result in behavioral harassment to harbor seals at a distance of 492 feet (150 meters) and to other pinnipeds (California sea lions and Steller sea lions) at a distance of 154 feet (47 meters) (Table 3.4–7). Vibratory pile driving noise would likely result in behavioral harassment to harbor seals at a distance of 62 feet (19 meters) and to other pinnipeds at a distance of 20 feet (6 meters) (Table 3.4–7). The areas encompassed by these threshold distances are shown in Table 3.4–7 and a representative scenario of areas affected by above-threshold noise levels for an impact pile driving rig is shown in Figure 3.4–2. Other areas would be included in the above-threshold noise areas if the analysis was performed for pile driving rigs at other locations on the LWI structures.

**Table 3.4–7. Calculated Maximum Distances in Air to Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Noise Thresholds, LWI Alternative 2**

| Affected Area | Impact Behavioral Harassment Harbor Seal (90 dB RMS)[1] | Impact Behavioral Harassment Other Pinnipeds (100 dB RMS)[1] | Vibratory Behavioral Harassment Harbor Seal (90 dB RMS)[1] | Vibratory Behavioral Harassment Other Pinnipeds (100 dB RMS)[1] |
|---|---|---|---|---|
| Distance to Threshold[1] | 492 ft (150 m) | 154 ft (47 m) | 62 ft (19 m) | 20 ft (6 m) |
| Area Encompassed by Threshold | 0.03 sq mi (0.07 sq km) | 0.003 sq mi (0.007 sq km) | 12,076 sq ft (1,134 sq m) | 1,216 sq ft (113 sq m) |

dB = decibel; ft = feet; m = meter; sq ft = square feet; sq km = square kilometer; sq m = square meter; sq mi = square mile; RMS = root mean square

1. Sound pressure levels used for calculations were 110 dB RMS re 20 µPa at 50 feet (15 meters) (Section 3.9.3.2.2) for impact hammer for 24-inch (60-centimeter) steel pile, and 92 dB RMS re 20 µPa at 50 feet (15 meters) for vibratory driver for 24-inch steel pile. All distances are calculated over water.

The distance between the south LWI project site and haul-out sites at Delta Pier is 1,000 feet (300 meters) and the distance between the north LWI project site and haul-out sites is 1 mile (1.6 kilometers), both of which would be beyond the airborne behavioral harassment threshold for California sea lion and Steller sea lions. Haul-out sites on the existing PSB at the south end of the WRA are immediately adjacent to the south LWI site and would be within the threshold for behavioral disturbance; however, some individuals that are hauled out on a portion of the PSB may be disturbed by pile driving. The airborne behavioral harassment threshold for harbor seal would encompass portions of Delta Pier and the existing PSB, although this species was not observed hauled out in this area during at-sea marine mammal surveys (Tannenbaum et al. 2009a, 2011a).

Harbor seals were observed swimming in the threshold area during these surveys, however, and may be susceptible to airborne noise disturbance resulting from pile driving. No threshold has been identified for injury to marine mammals due to airborne sound.

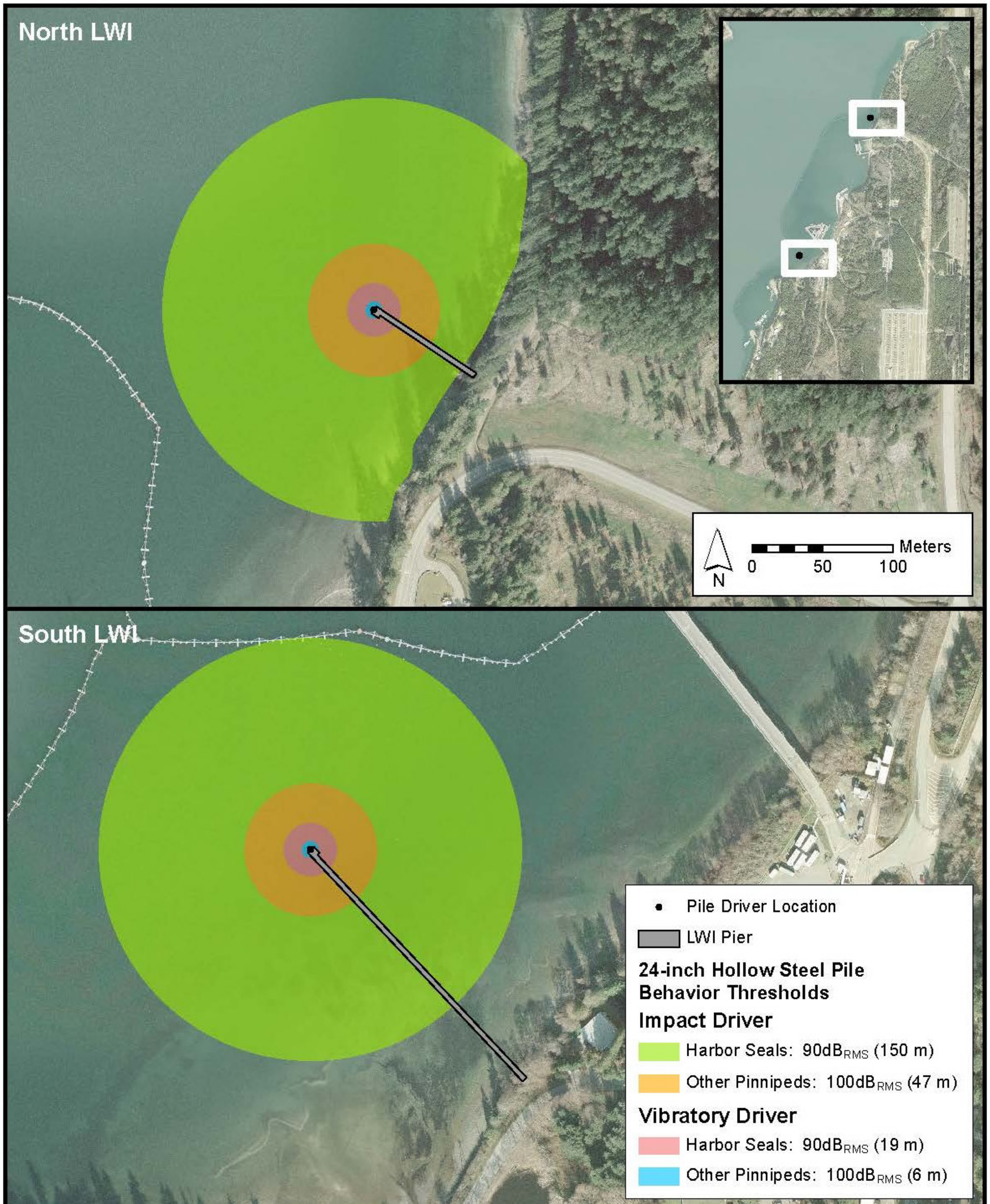


Figure 3.4-2. Representative View of Affected Areas for Marine Mammals due to Airborne Pile Driving Noise during Construction of LWI Alternative 2

*CALCULATIONS OF EXPOSURE OF MARINE MAMMALS TO NOISE IMPACTS*

The analysis approach in the following section focuses on quantifying potential exposure of marine mammals to project impacts based on their density in the project area and the duration of project activities that may affect these species. The term exposure in this analysis signifies "take" under the MMPA, as detailed above in Section 3.4.2.2.2, under Underwater Noise. The following species are included in the analysis because their occurrence in Hood Canal has been confirmed by specific observations during the past decade: harbor seal, California sea lion, Steller sea lion, harbor porpoise, and transient killer whale (see Section 3.4.1 for marine mammal species accounts).

*Method of Incidental Taking (MMPA)*

Pile driving activities associated with construction of the LWI, as described above, have the potential to disturb or displace marine mammals, but injury is not anticipated given the methods of installation and measures designed to minimize the possibility of injury to marine mammals. Vibratory pile drivers would be the primary method of installation, which are not expected to cause injury to marine mammals due to the relatively low source levels (161 dB). Also, no impact pile driving would occur without bubble curtain, and pile driving would either not start or would be halted if marine mammals approach the shutdown zone. Although the Proposed Action may affect the prey and other habitat features of marine mammals, none of these effects is expected to rise to the level of take under MMPA, as described in the following sections. The ESA-listed Southern Resident killer whale was included in the analysis of indirect effects on its prey base, as described above in Section 3.4.2.2.2, under Prey Availability, but is not carried forward in the noise effects analysis because its occurrence has not been confirmed in Hood Canal since 1995. The humpback whale is not included in the noise effects analysis because they are rarely observed in Hood Canal, and infrequent sightings of the species have shown them occurring at the end of the in-water work window, when pile driving activities would be concluded. Therefore, no noise impacts are expected for Southern Resident killer whale or humpback whale.

*Description of Exposure Calculation*

The calculations presented here rely on the best data currently available for marine mammal population densities and abundance in Hood Canal (Navy 2013). The Navy's database (Navy Marine Species Density Database [NMSDD]) is the overarching database for all Navy projects within its operating areas. The Navy has utilized the NMSDD, in tandem with local observational data, to support several pile driving projects whose applications have been submitted to NMFS. The Northwest region's NMSDD densities were finalized in 2012. The calculations presented in this section rely on NMSDD data for harbor seals and harbor porpoises that occur in Hood Canal (Table 3.4–8). Site-specific abundance data are available from monitoring of Steller sea lions and California sea lions at NAVBASE Kitsap Bangor (see Tables 3.4–9 and 3.4–11, respectively; Navy 2015a). Transient killer whale exposure calculations are described below.

**Table 3.4–8. Marine Mammal Species Densities in Hood Canal**

| Species | Density in Hood Canal[1] animals/sq mi (animals/sq km) | Months Present in Hood Canal |
|---|---|---|
| Harbor seal[2] | 20.55 (7.93) | Year round |
| Harbor porpoise | 0.38 (0.149) | Potentially year round |

Source: Navy 2013

sq km = square kilometer; sq mi = square mile

1. Density is the largest estimate available from fall, summer, and winter estimates. Spring (March 1 through May 31) estimates were not included because the time period is outside the in-water work period.
2. Includes correction for the estimated portion of the harbor seal population that is not hauled out at a given time (London et al. 2012).

Successful implementation of mitigation measures (visual monitoring and the use of shutdown zones) would preclude injury exposures for marine mammals, but exposures to pile driving noise would result in behavioral disturbance. Results of noise effects exposure assessments should be regarded as conservative overestimates that are influenced by limited occurrence data and the assumption that individuals may be present every day of pile driving.

The method for calculating potential exposures to impact and vibratory pile driving noise includes the following assumptions:

- Each species' population is at least as large as any previously documented highest population estimate.
- Each species would be present in the project area during construction at the start of each day, based on observed patterns of occurrence in the absence of construction. The timeframe for exposures would be one potential exposure per individual per 24 hours.
- All piles to be installed would have an underwater noise disturbance distance equal to the noise disturbance distance (Zone of Influence[1] [ZOI]) from the pile that would cause the greatest noise disturbance (i.e., the pile farthest from shore). The underwater ZOI was calculated based on the pile driving method that produces the largest ZOI (i.e., vibratory pile driving). Although some piles would be installed with an impact hammer, the ZOI for an impact hammer would be encompassed by the larger ZOI for the vibratory driver.[2]
- All piles to be installed would have an airborne noise disturbance distance equal to the noise disturbance distance (ZOI) from the pile that would cause the greatest noise disturbance (i.e., the pile farthest from shore). The airborne ZOI was calculated based on the pile driving method that produces the largest ZOI (i.e., impact pile driving). Impact pile driving was assumed to occur on all days of pile driving. Exposures to airborne noise were only calculated for pinnipeds.

---

[1] Zone of Influence (ZOI) is the area encompassed by all locations where the sound pressure levels equal or exceed the threshold being evaluated.

[2] Although pile driving noise source levels are higher for impact-driven piles than vibratory-driven piles, the behavioral disturbance criterion for vibratory-driven piles (120 dB RMS) encompasses a much greater area than the criterion for impact-driven piles (160 dB RMS).

- Pile driving would occur up to 80 days for LWI Alternative 2.
- In the absence of site-specific underwater acoustic propagation modeling, the practical spreading loss model was used to determine the ZOI for underwater noise.
- Some type of mitigation (i.e., bubble curtain) would be used for impact pile driving and achieve 8 dB reduction in source levels.

For species with density estimates (e.g., harbor seal, harbor porpoise), exposures are estimated by:

Exposure estimate = (n * ZOI)* X days of pile driving activity,

where:

n = density estimate used for each species,
ZOI = noise threshold zone of influence (ZOI) impact area, and
X = number of days of pile driving estimated based on the total number of piles and the estimated number of piles installed per day.

The ZOI impact area is the estimated range of impact on the noise criteria thresholds for both underwater and airborne noise. The distances specified in Tables 3.4–6 and 3.4–7 for LWI were used to calculate the overwater areas that would be encompassed within the threshold distances for injury or behavioral harassment. All calculations were based on the estimated threshold ranges using a bubble curtain with 8 dB attenuation as a mitigation measure for impact pile driving. The greatest area affected by construction noise was defined as the calculated distance from LWI pile driving locations to the behavioral harassment threshold (120 dB sound pressure level) or the greatest line-of-sight distance (3.4 miles [5.4 kilometers]) that underwater sound waves could travel from pile driving locations unimpeded by land masses (Figure 3.4–1). The affected area was determined to be 11.0 square miles (28.5 square kilometers) (Table 3.4–6).

The product of n*ZOI was rounded to the nearest whole number before multiplying by the number of pile driving days. If the product of n*ZOI rounds to zero, the number of exposures calculated is zero regardless of the number of pile driving days. The exposure assessment methodology is an estimate of the numbers of individuals exposed to the effects of pile driving activities exceeding NMFS-established thresholds for underwater and airborne noise. Of significant note in these exposure estimates is that (1) implementation of one mitigation method (bubble curtain use during impact pile driving) would result in quantifiable reduction in exposures of marine mammals to pile driving noise, (2) successful implementation of other mitigation measures such as soft starts for pile driving is not reflected in exposure estimates, and (3) exposure calculations do not include Level A take because marine mammal monitoring/shutdown implementation would preclude exposure to injurious noise levels. Results from acoustic impact exposure assessments should be regarded as conservative overestimates that are strongly influenced by limited marine mammal population data.

For species with counts of animals in the project area (Steller and California sea lions) available, exposures are estimated by:

Exposure estimate = (Abundance) * X days of pile driving activity,

where:

Abundance = average monthly maximum counts during the months when pile driving will occur.

*SUMMARY OF PROJECT IMPACTS AND ESTIMATED EXPOSURES FOR SPECIES PRESENT IN THE LWI PROJECT AREA*

*Steller Sea Lion*

Steller sea lions are occasionally present in Washington inside waters from late fall to late spring (Jeffries et al. 2000; NMFS 2010) and have been detected in Hood Canal during the period from late September to May (Bhuthimethee 2008, personal communication; Navy 2015a; Table 3.4-9). Most detections of Steller sea lions in Hood Canal have been individuals hauled out on submarines docked at Delta Pier (Navy 2015a).

**Table 3.4–9. Steller Sea Lions Observed at NAVBASE Kitsap Bangor, April 2008–December 2015**

| | | Maximum Number of Steller Sea Lions Observed in Single Survey | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | MAX Average |
| In-water Work Window July 15 - January 15 | July | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | August | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | September | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 1 |
| | October | 0 | 0 | 4 | 3 | 6 | 9 | 3 | 4 |
| | November | 4 | 6 | 4 | 5 | 4 | 11 | 13 | 7 |
| | December | 0 | 3 | 2 | 4 | 4 | N/A | 7 | 3 |
| | January | 0 | 2 | 1 | 3 | N/A | 1 | 6 | 2 |
| | February | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 1 |
| | March | 0 | 2 | 2 | 3 | N/A | 1 | 1 | 2 |
| | April | 0 | 4 | 6 | 4 | 0 | 2 | 1 | 2 |
| | May | 0 | 0 | 6 | 3 | 0 | 2 | 0 | 2 |
| | June | 0 | 0 | 0 | 0 | N/A | 0 | 0 | 0 |
| | | | | | | | | **Average of in-water work window** | **2** |

Source: Navy 2015a
N/A = no survey was conducted

Although the Navy has determined a density for Steller sea lions in Hood Canal (Navy 2013), when more site-specific data are available it is preferable to use that data to determine the number of individuals that may be exposed to noise effects. This is because a density analysis assumes an even distribution of animals, whereas Steller sea lion distribution within the project area actually is concentrated at Delta Pier. Therefore, the noise exposure calculation for Steller sea lions uses the average of monthly maximum abundance of the species during the in-water work window, defined as the average of the monthly maximum number of individuals per month present during surveys at Delta Pier from July to January during the years 2008 through 2015. The abundance trend for Steller sea lions at Delta Pier has increased since they were first detected in November 2008.

Exposures to underwater pile driving noise were calculated using the abundance-based formula presented above, under Description of Exposure Calculation. Table 3.4–10 depicts the number of potential behavioral harassment exposures that are estimated from underwater vibratory and impact pile driving. Using the abundance-based analysis, the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), and an average daily abundance of 2 individual Steller sea lions, the noise exposure formula above predicts 160 exposures to underwater noise within the behavioral harassment threshold for vibratory pile installation over the 80 days of pile driving.

**Table 3.4–10. Number of Potential Exposures of Marine Mammals, 24-inch (60-centimeter) Steel Piles, LWI Alternative 2**

| Species | Underwater Behavioral Harassment | Airborne Behavioral Harassment |
|---|---|---|
| | All Species (120 dB RMS) | Harbor Seal (100 dB RMS), Other Pinnipeds (90 dB RMS) |
| Steller sea lion | 160 | 0 |
| California sea lion | 2,880 | 0 |
| Harbor seal | 18,080 | 0 |
| Harbor porpoise | 320 | N/A |
| Transient killer whale | 180 | N/A |

All underwater sound levels are expressed as dB re 1 μPa; all airborne sound levels are expressed as dB re 20 μPa.
dB = decibel; RMS = root mean square

Steller sea lions are unlikely to be injured by pile driving noise because they are unlikely to be within the injury threshold distance for pile driving noise (16 feet [5 meters] from the driven pile). Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see the Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of sea lions in or near the shutdown zones, thereby reducing the potential for injury.

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Sea lions hauled out on submarines at Delta Pier would be beyond the areas encompassed by the airborne noise behavioral harassment threshold for both south and north LWIs (Figure 3.4–2) and are unlikely to be affected by construction activities. Animals swimming with their heads above the water would potentially be affected by elevated airborne pile driving noise within a small ZOI (154 feet [47 meters]). Given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, pinniped takes would already occur as a result of underwater exposures. Therefore, no additional takes for exposure to airborne pile driving noise were requested for Steller sea lions, and the total number of behavioral harassment exposures over the entire pile driving period for this alternative is estimated to be 160 (all underwater) (Table 3.4-10).

Steller sea lions would most likely avoid waters within the areas affected by above-threshold noise levels during impact pile driving around the LWI project sites. Steller sea lions exposed to elevated noise levels could exhibit behavioral changes such as avoidance of the affected area, increased swimming speed, increased surfacing time, or decreased foraging activity. Pile driving would occur only during daylight hours, and therefore would not affect nocturnal movements of Steller sea lions in the water. Most likely, Steller sea lions affected by elevated underwater or airborne noise would move away from the sound source and be temporarily displaced from the affected areas. However, they likely would continue using submarines at Delta Pier as haul-out sites during pile driving, based on evidence cited in Section 3.4.1.2.3 regarding responses of pinnipeds to construction noise including pile driving. Given the absence of any rookeries and only one haul-out area near the project site (i.e., submarines docked at Delta Pier), and infrequent attendance by a small number of individuals at this site, potential disturbance exposures would have a negligible effect on individual Steller sea lions and would not result in population-level impacts.

The prey base of Steller sea lions includes forage fish and salmonids, which potentially would be less available for predators within the fish injury exposure and behavioral harassment zones (described in Section 3.3) during the 6-month, in-water construction window. The potential impact on Steller sea lions would be a localized (within the fish behavioral harassment zones), temporary loss of foraging opportunities (during in-water construction) and potential exposure to behavioral harassment as they transit the project area.

*California Sea Lion*

No regular haul-outs of California sea lions were documented during aerial surveys of pinniped populations in Hood Canal over a decade ago (Jeffries et al. 2000), but Navy observations of animals hauled out on submarines and the PSB on NAVBASE Kitsap Bangor in recent years indicate that California sea lions are present in Hood Canal during much of the year (Navy 2015a). During the in-water construction period (July 15 to January 15), the largest monthly attendance averaged for each month ranged from 1 to 74 individuals. The largest monthly average (74 animals) during the in-water work window was recorded in November, as was the largest daily count (122) (Table 3.4–11). The likelihood of California sea lions being present at the Bangor waterfront was greatest from October through May, when the frequency of occurrence in surveys was at least 0.80 (i.e., 80 percent of surveys had California sea lions present).

The noise exposure analysis for California sea lions is similar to the analysis described above for Steller sea lions. The Navy used the average maximum abundance of the species during the in-water work window, defined as the average of the monthly maximum number of individuals present during surveys at Delta Pier from July 15 to January 15. The average of the monthly maximum number present during the in-water work window was approximately 36 animals (Table 3.4-11). Using the abundance-based analysis and the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), and an average daily abundance of 36 individual California sea lions, the noise exposure formula above predicts 2,880 exposures to underwater noise within the behavioral harassment threshold for vibratory pile installation over the 80 days of pile driving.

**Table 3.4–11. California Sea Lions Observed at NAVBASE Kitsap Bangor, April 2008–December 2015**

| | | Maximum Number of California Sea Lions Observed in Single Survey | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | MAX Average |
| In-water Work Window | July 15 - January 15 | | | | | | | | |
| | July | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 1 |
| | August | 0 | 1 | 3 | 4 | 5 | 0 | 15 | 4 |
| | September | 12 | 32 | 33 | 14 | 11 | 35 | 44 | 26 |
| | October | 47 | 44 | 42 | 56 | 70 | 88 | 84 | 62 |
| | November | 50 | 58 | 42 | 81 | 70 | 122 | 93 | 74 |
| | December | 27 | 38 | 50 | 64 | 69 | N/A | 63 | 52 |
| | January | 4 | 44 | 33 | 43 | N/A | 48 | 43 | 36 |
| | February | 28 | 34 | 42 | 48 | 44 | 42 | 32 | 39 |
| | March | 37 | 40 | 54 | 82 | N/A | 65 | 55 | 56 |
| | April | 46 | 51 | 66 | 52 | 32 | 49 | 48 | 49 |
| | May | 33 | 17 | 54 | 18 | N/A | 20 | 12 | 26 |
| | June | 3 | 12 | 17 | 4 | N/A | 8 | 8 | 9 |
| | | | | | | | | **Average of in-water work window** | **36** |

Source: Navy 2015a
N/A = no survey was conducted

Sea lions are unlikely to be injured by pile driving noise because they are unlikely to be within the injury threshold distance for pile driving noise (16 feet [5 meters] from the driven pile). Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see the Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of sea lions in or near the shutdown zones, thereby reducing the potential for injury.

California sea lions would most likely avoid waters within the areas affected by above-threshold noise levels during impact pile driving around the LWI project sites. Sea lions exposed to elevated noise levels could exhibit behavioral changes such as avoidance of the affected area, increased swimming speed, increased surfacing time, or decreased foraging activity. Pile driving would occur only during daylight hours, and therefore would not affect nocturnal movements of sea lions in the water. Most likely, sea lions affected by elevated underwater or airborne noise would move away from the sound source and be temporarily displaced from the affected areas. However, they may continue using vessels at Delta Pier as haul-out sites during pile driving, based on evidence cited in Section 3.4.1.2.3 regarding responses of pinnipeds to construction noise including pile driving. Given the absence of any rookeries and only one haul-out area near the project site (i.e., submarines docked at Delta Pier and pontoons of the PSB), potential disturbance exposures would have a negligible effect on individual California sea lions and would not result in population-level impacts.

The prey base of California sea lions includes forage fish and salmonids, which would be less available for predators within the fish injury exposure and behavioral harassment zones (described in Section 3.3) during the 6-month, in-water construction window. The potential impact on California sea lions would be a localized (within the fish behavioral harassment zone), temporary loss (during in-water construction) of foraging opportunities, and potential exposure to behavioral harassment as they transit the project area.

*Harbor Seal*

Harbor seals are the most abundant marine mammal in Hood Canal. Jeffries et al. (2003) completed a comprehensive stock assessment of the Hood Canal in 1999 (on September 21 between the hours of 3:00 and 4:00 p.m.) and counted 711 harbor seals hauled out. An estimate of the Hood Canal harbor seal population size was based on this survey data and haul-out behavior described by London et al. (2012), who calculated an approximate correction factor for the survey count. Using haul-out probability from Figure 4 in London et al. (2012) the correction factor is calculated as follows:

> Approximate probability of an animal to be hauled out during that time frame in that month is 0.20. The inverse of this (1/0.20) provides a correction factor of 5.0. When applied to the survey count data of 711, the correction factor yields a population estimate of 3,555 animals.

Exposures to underwater and airborne pile driving noise were calculated using a density derived from the number of harbor seals that may be present in the water at any one time (80 percent of 3,555 or 2,844 individuals), divided by the area of Hood Canal (138.4 square miles [358.4 square kilometers]) (Jeffries et al. 2003; London et al. 2012). The density of harbor seals calculated in this manner is 20.55 individuals/square mile [7.93/square kilometer]. The Navy acknowledges that a uniform density spread out over the Hood Canal is not ideal, and that the density would be higher around haul-out sites such as Dabob Bay and farther south in Hood Canal, which are 10 miles away from Bangor and those Bangor activities. Since the haul-out sites are not located near the Bangor waterfront, density is expected to be much lower near the project area. However, since a detailed geographically stratified density estimate is not currently available, the analysis uses the uniform density to calculate exposures to pile driving noise. Therefore, the exposure estimate for harbor seals presented here is likely a significant overestimate.

The airborne exposure calculations assumed that 100 percent of the in-water injury exposures would be available at the surface to be exposed to airborne sound. Exposures to underwater noise were calculated with the formula in Section 3.4.2.2.2, under Underwater Noise, and the ZOI in Table 3.4–6. Table 3.4–10 depicts the number of behavioral harassment exposures that are estimated from vibratory and impact pile driving both underwater and in-air.

Based on the density analysis of 20.55 individuals/square mile (7.93/square kilometer) and using the most conservative criterion for behavioral disturbance (the 120 dB vibratory harassment threshold with an area of 11.0 square miles [28.5 square kilometers]), up to 226 individual harbor seals may experience sound pressure levels on a given day that would qualify as behavioral harassment. The estimated number of individuals exposed per day amounts to approximately 6 percent of the estimated population, and as noted above is likely a significant overestimate of potential exposures. Thus, not all animals in the population would be expected to be exposed to the activities at Bangor but only a subset of the population that may travel through or haul-out on manmade structures near the waterfront. Furthermore, the behavioral harassment does not appear to be biologically significant based on observations from waterfront surveys conducted by the

Navy (Navy 2015a): (1) harbor seals are always present in Bangor waters and occasionally use manmade structures (underside of piers, ladders in the water, wavescreen, floating oil boom, etc.) as haulouts; and (2) pupping occurs from the northern end to the southern end of the waterfront.

Over the 80 days of pile driving, the noise exposure formula above predicts 18,080 exposures to noise within the behavioral harassment threshold for vibratory pile driving. Zero exposures to underwater noise were calculated within the injury threshold (with an area of 850 square feet [79 square meters]). Zero exposures to airborne pile driving noise were calculated by the formula above. Therefore, the total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 18,080 (all underwater) (Table 3.4–10).

Harbor seals would most likely avoid waters within areas affected by above-threshold noise levels during impact pile driving around the LWI project sites. They are unlikely to be injured by pile driving noise because they are unlikely to be within the injury threshold distance for pile driving noise (16 feet [5 meters] from the driven pile). Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see the Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of harbor seals in or near the shutdown zones, thereby reducing the potential for injury.

The prey base of harbor seals includes forage fish and salmonids, which would be less available for predators within the fish injury exposure and behavioral harassment zones (described in Section 3.3) during the 6-month, in-water construction window. The potential impact on harbor seals would be a localized (within the fish behavioral harassment zone), temporary loss of foraging opportunities (during in-water construction) and potential exposure to behavioral harassment as they transit the project area.

*Harbor Porpoise*

Harbor porpoises may be occasionally present in Hood Canal year round and conservatively are assumed to use the entire area. The Navy conducted boat surveys of the waterfront area from July to September 2008 (Tannenbaum et al. 2009a) and November 2009 to May 2010 (Tannenbaum et al. 2011a). During one of the surveys a single harbor porpoise was sighted in May 2010 in deeper waters in the vicinity of EHW-1. Overall, these nearshore surveys indicated a low occurrence of harbor porpoise within waters adjacent to the base. Surveys conducted during the TPP indicate that the abundance of harbor porpoises within Hood Canal in the vicinity of NAVBASE Kitsap Bangor is greater than anticipated from earlier surveys and anecdotal evidence (HDR 2012). During these surveys, while harbor porpoise presence in the immediate vicinity of the base (i.e., within 0.6 mile [1 kilometer]) remained low, harbor porpoises were frequently sighted within several kilometers of the base, mostly to the north or south of the project area, but occasionally directly across from the proposed EHW-2 project site on the far side of Toandos Peninsula. These surveys reported 38 individual harbor porpoise sightings on tracklines of specified length and width, resulting in a density of 0.149 individuals/square kilometer.

The density used in the underwater sound exposure analysis was 0.149 animals/square kilometer (Navy 2013). Exposures to underwater pile driving noise were calculated using the formula in

Section 3.4.2.2.2, under Underwater Noise, and the ZOI in Table 3.4–6. Table 3.4–10 depicts the number of potential behavioral harassment exposures that are estimated from underwater vibratory and impact pile driving.

Based on the density analysis of 0.38 individuals/square mile [0.149/square kilometer] (Navy 2013) and using the most conservative criterion for behavioral disturbance (the 120 dB vibratory harassment threshold with an area of 11.0 square miles [28.5 square kilometers]), up to 4 individual harbor porpoises may experience sound pressure levels on a given day that would qualify as behavioral harassment. Over the 80 days of pile driving, the noise exposure formula above predicts 320 exposures to noise within the behavioral harassment threshold for vibratory pile driving. Zero exposures to underwater noise were calculated within the injury threshold (with an area of 16,372 square feet [1,521 square meters]). The total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 320 over the estimated 80 days of pile driving (Table 3.4–10).

Harbor porpoise that are exposed to pile driving noise could exhibit behavioral reactions such as avoidance of the affected area. Harassment from underwater noise impacts is not expected to be significant because it is estimated that only a small number of harbor porpoise would ever be present in the project area. Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see the Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of harbor porpoise in or near the shutdown zones, thereby precluding the potential for injury.

*Transient Killer Whale*

Transient killer whales are rarely present in Hood Canal. In 2003 and 2005, groups of transient killer whales (6 to 11 individuals per event) visited Hood Canal to feed on harbor seals and remained in the area for significant periods of time (59 to 172 days) between the months of January and July (London 2006). These whales used the entire expanse of Hood Canal for feeding. No other confirmed sightings of transient killer whales in Hood Canal have been reported.

Even though transient killer whales are rare in Hood Canal and an applicable density value is not available, the Navy calculated potential exposures for the LWI project in the event that a group may occur within the LWI behavioral disturbance ZOI. For transient killer whales, there have only been two documented time periods of occurrence within Hood Canal and, therefore, a reliable density estimate is not available.

Take estimates were calculated based on the in-water work associated with the LWI Alternative 2: Pile Supported Pier. The pier would consists of 136 permanent 24-inch piles and 120 temporary trestle piles, and would take no more than 80 days to construct within the in-water work window (see Section 1.1.1.3.2). Exposures to underwater pile driving were calculated using the second equation described in the *Description of Exposure Calculation* (page 3.4-38) where the exposure estimate was determined by multiplying the group size times the number of days transient killer whales would be anticipated in the Hood Canal during pile driving activities.

West Coast transient killer whale mean group size in the Salish Sea was 4 individuals during the period from 1987–1993 (mode = 3 individuals) (Baird and Dill 1996). More recently, during the period from 2004–2010, mean group size appears to have increased to 5 individuals (mode = 4 individuals) (Houghton et al. 2015). According to Houghton unpublished data, the most commonly observed group size in Puget Sound (specifically south of Admiralty Inlet) from 2004–2010 data was 6 whales (mode = 6, mean = 6.88) (Houghton 2012, personal communication).

Based on the two documented residence times transient killer whales remained in Hood Canal (59 to 172 days between the months of January and July), NMFS concluded that whales could be exposed to behavioral disturbance due to pile driving noise for 30 days (NMFS 2014). The 30 day estimate reasonably assumes that the whales would not remain in the area for the typical residence time due to the harassing stimuli.

Using this rationale, 180 potential exposures of transient killer whales are estimated (6 animals times 30 days of exposure). Based on this analysis, the Navy requests Level B incidental takes for behavioral harassment of 180 killer whales. Animals of any age or sex could be exposed. Any exposures are anticipated to be short in duration as animals transit through the ZOI during vibratory pile driving.

Transient killer whales that are exposed to pile driving noise could exhibit behavioral reactions such as avoidance of the affected area. Harassment from underwater noise impacts is not expected to be significant because it is estimated that only a small number of transient killer whales would ever be present in the project area. Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see the Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of transient killer whales in or near the shutdown zones, thereby precluding the potential for injury.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 2

LWI Alternative 2 would create an in-water pier that would be 280 feet (85 meters) long at the north location and 730 feet (223 meters) long at the south location. Cetaceans are unlikely to be present in the shallow nearshore waters affected by the LWI. Pinnipeds may swim through the area but are highly mobile and their movements would not be significantly affected by the presence of this in-water barrier. Pinnipeds would encounter the mesh that would extend from the bottom of the pier walkway to the seafloor and likely swim around it. The mesh would be a high visibility material that is not directly comparable to fishing nets but rather would be more like a semi-flexible grate with fairly wide partitions between the mesh openings. Unlike fishing nets, the LWI mesh would be permanently fixed, highly visible, and would not provide any attractant to marine mammals because it is not designed for, nor would it be likely to trap fish. There may be some potential for entanglement of pinnipeds, such as curious juvenile harbor seals that may attempt to insert their heads in the mesh. Information in the literature on entanglement of marine mammals in gill nets, trawl nets, other fishing gear, and aquaculture net pens does not provide much insight into the potential for adverse impacts due to installation of the mesh at the LWI piers. This is because of physical differences between the LWI mesh and these other materials, as well as active deployment of fishing nets as opposed to the passive deployment of the LWI mesh. All factors considered, the risk would not be significant for most marine mammals in the project area.

*Prey Availability*

The LWI would impact marine mammals by changing their prey base (primarily salmonids and schooling fishes). The potential long-term impacts on the prey base are discussed in Section 3.4.2.2.2. The LWI would permanently convert approximately 0.14 acre (0.06 hectare) of benthic habitat as discussed in Section 3.2.2.2.2 (Table 3.2–8) with a corresponding loss of habitat suitability and productivity for some prey species. However, it is possible that the LWI pier and mesh may facilitate predation because the piles and mesh would create a physical barrier to movements of juvenile salmonids and forage fish (Section 3.3.2.2.2) in the nearshore environment, causing them to hesitate at the mesh and/or migrate around the seaward ends of the piers. These fish may be more vulnerable to marine mammal predators. Adult salmonids are less dependent on nearshore habitats than juveniles and are more mobile, but they may congregate at the seaward ends of the LWI, where they would be more exposed to marine mammal predation. Artificial lighting used during security responses at the LWI is expected to have negligible impact on fish species hunted by marine mammals, as described in Section 3.3.2.2.2. Thus, localized changes to the prey base for some marine mammals are possible with the proposed project but these changes cannot be quantified with available information.

Prey populations in the context of the inside waters of Washington State and Hood Canal, which encompass the foraging area of the marine mammal species that occur in the LWI project area, would not be significantly impacted by the construction and future operation of Alternative 2. Operations impacts of the LWI would be limited to the small area including an adjacent to the structures. The Mitigation Action Plan (Appendix C) describes the marine habitat mitigation actions that the Navy would undertake as part of the Proposed Action. This habitat mitigation action would compensate for impacts of the Proposed Action to marine habitats and species.

*Noise and Visual Disturbance*

Operation of the LWI would include increased noise and visual disturbance from human activity and artificial light. Under existing conditions, the Bangor waterfront produces an environment of complex and highly variable noise and visual disturbance for marine mammals, although Steller and California sea lions haul out on manmade structures and harbor seals regularly forage in the nearshore and deeper waters along the Bangor waterfront in close proximity to ongoing operations. Because future operations of the LWI would not exceed existing levels, most individual marine mammals are likely to habituate to the post-construction activity levels, as they have habituated to activity levels at other developed portions of the waterfront. Thus, no additional MMPA take is expected with operation of the LWI.

Maintenance of the LWI would include routine inspections, repair, and replacement of facility components as required (but no pile replacement). These activities could affect marine mammals through noise impacts and increased human activity and vessel traffic. However, noise levels would not be appreciably higher than existing levels elsewhere at the Bangor industrial waterfront, to which marine mammals appear to have habituated. Further, measures would be employed (Section 3.1.1.2.3) to avoid discharge of contaminants to the marine environment. Therefore, maintenance would have negligible impacts on marine mammals.

California sea lions, Steller sea lions, and harbor seals use various manmade structures at the Bangor waterfront for hauling out, including pontoons that support the existing PSB. The shoreline in the project area is not used for hauling out by any pinniped species under existing conditions, and it is unlikely that pinnipeds would haul out on the shoreline in the vicinity of the LWI under Alternative 2 in the future. The LWI piers would be vertical structures with deck surfaces that are 10 feet (3 meters) above MHHW and therefore inaccessible to pinnipeds, but floating pontoons of the PSB would likely be used as haul outs. The south LWI and north LWI shoreline abutments would be vertical structures 12 feet (4 meters) and 38 feet (12 meters) high, respectively, and would not be accessible for hauling out.

#### 3.4.2.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

LWI Alternative 3 would modify the existing PSB system to extend across the intertidal zone and attach to concrete abutments at the shoreline, but would not include the pile-supported pier proposed under Alternative 2. As described in Chapter 2, no piles would be installed in the water and the PSB guard panels would be less of a barrier to nearshore movement of marine biota than the Alternative 2 pier and underwater mesh barrier. LWI Alternative 3 would include the same concrete abutments described for LWI Alternative 2. Consequently, pinnipeds potentially would be exposed to airborne noise associated with pile driving for these structures, all of which would be installed from the shoreline in the dry. Long-term operations of the LWI under Alternative 3 would result in some potential indirect effects on prey species, although the consequences for marine mammal populations are likely to be insignificant.

##### CONSTRUCTION OF LWI ALTERNATIVE 3

Marine mammals are expected to avoid the construction areas because of increased vessel traffic, noise and human activity, and increased turbidity. General construction period impacts on water quality, vessel traffic, prey availability, and non-pile-driving construction noise would be the same as for LWI Alternative 2, but overall LWI Alternative 3 would have fewer and shorter-lasting impacts on marine mammals in the project area.

The following sections describe how construction would affect the abundance and distribution of marine mammals present or potentially present at NAVBASE Kitsap Bangor, and compares the effects of LWI Alternative 3 with effects of LWI Alternative 2.

*WATER QUALITY*

Tug and barge operations and placement of PSB buoy anchors would resuspend contaminants that may be present in sediments and increase turbidity levels, as discussed in Section 3.1.2.2.3. A smaller seafloor area (up to 12.7 acres [5.2 hectares]) would be disturbed under LWI Alternative 3 compared to Alternative 2 (approximately 13.1 acres [5.3 hectares]) (Table 3.2–8). Similar to Alternative 2, water quality effects of Alternative 3 including seafloor disturbance would be temporary and localized, and construction-period impacts are not expected to exceed water quality standards. Measures for the protection of marine water quality and the seafloor would be implemented to minimize impacts (Mitigation Action Plan, Appendix C).

Marine mammals are expected to avoid the immediate construction area due to increased vessel traffic, noise and human activity, increased turbidity, and potential difficulty in finding prey. Because suspended sediment and contaminant concentrations would be low, and exposures would be localized, no impacts on marine mammals are expected due to changes in water quality during construction. Considering the wide distribution of marine mammals in inland marine waters, water quality changes due to LWI Alternative 3 would not significantly affect these populations or overall distribution.

*VESSEL TRAFFIC*

Vessel movements associated with construction of the LWI under Alternative 3 have the potential to impact marine mammals directly by accidentally striking or disturbing individual animals. Construction activity involving vessel traffic may occur over 12 months. However, because no in-water piles would be installed with LWI Alternative 3, lower levels of vessel traffic including barge and tug trips would be required (3 total round trips with Alternative 3 compared to 16 total round trips with Alternative 2). Thus, Alternative 3 would result in lower overall disturbance levels for marine mammals in the project vicinity, along with reduced likelihood of collision, and would likely displace them for shorter periods of time. The affected area for both alternatives would be limited to the project vicinity and, relative to the wide distribution of marine mammal populations in inland waters, would not represent a significant impact.

*PREY AVAILABILITY*

Construction of Alternative 3 would displace and degrade benthic habitats and marine vegetation used by prey populations for foraging and refuge as described in Section 3.3.2.2.3. However, the amount of foraging and refuge habitat supporting prey populations that potentially would be degraded by project construction would be slightly less under Alternative 3 (up to 12.7 acres [5.2 hectares]) than Alternative 2 (up to 13.1 acres [5.3 hectares]) (Table 3.2–8), and the disturbance would occur during only one in-water work season (Alternative 2 would have two in-water work seasons). Under Alternative 3 there would be fewer barriers to fish movements in the nearshore because no pier/mesh barrier system would be installed with this alternative (although the PSB guard panels would be something of a barrier to juvenile salmon migration). In addition, there would be no disturbance of fish due to in-water pile driving. Thus, adverse behavioral responses of prey populations due to project construction would be greatly reduced under Alternative 3, although the magnitude of the effects of the project alternatives cannot be quantified with available information.

While project construction may affect the prey base of pinnipeds that occur in the immediate project vicinity, relative to the wide distribution of marine mammal species and their prey resources in inland marine waters, effects of Alternative 3 on prey availability would not amount to a significant impact on marine mammal population numbers and distribution. Alternative 3 may indirectly affect Southern Resident killer whales through their prey populations, but the project's effect on the species' prey base would be minimal. Therefore, the ESA effect determination for construction activities under LWI Alternative 3 is "may affect, not likely to adversely affect" Southern Resident killer whales. The project would have no effect on critical habitat for Southern Resident killer whales because no critical habitat has been designated in Hood Canal.

NOISE

As described in Section 2.1.1.3.3, Alternative 3 would require pile driving for the LWI abutments. A total of 31 36-inch (90-centimeter), 24 30-inch (76-centimeter), and 30 24-inch (60-centimeter) hollow steel piles would be driven in the dry using a land-based pile driving rig. Piles would be driven using vibratory and impact drivers as required. Unlike the pile-supported pier under Alternative 2, no in-water pile driving would be required for Alternative 3, and the total number of driven piles would be substantially fewer (136 permanent in-water piles, 120 temporary in-water piles, and 41 land-installed piles for Alternative 2 compared with 24 permanent and 20 temporary piles driven in the dry and 41 land-installed piles for Alternative 3). Exposure of marine mammals to pile driving noise would be limited to airborne noise impacts under Alternative 3, and the duration of the exposure would be substantially shorter. Up to 30 days of pile driving would be required for construction of Alternative 3 compared with up to 80 days of pile driving for Alternative 2.

With respect to airborne pile driving noise source levels and propagation (described in Section 3.9.3.2) and effects of elevated noise levels on the behavior of marine mammals, the analysis is the same for both project alternatives. The following comparison of noise impacts focuses on the number of exposures of marine mammals to elevated airborne pile driving noise. It is assumed that daily abundances of marine mammal species would be the same for both alternatives. As in the exposure analysis for Alternative 2, the airborne noise disturbance distance (ZOI) was calculated based on the pile driving method that produces the largest ZOI (i.e., impact pile driving). It is assumed that only pinnipeds would be affected by elevated airborne noise levels and, consequently, upland areas were eliminated from the ZOI. For 30-inch (76-centimeter) hollow steel piles, the thresholds for airborne impact pile driving noise would be reached at 413 feet (126 meters) for harbor seals and 131 feet (40 meters) for other pinnipeds (Table 3.4–12). Thresholds for vibratory pile driving would occur at shorter distances from the driven pile (59 feet [18 meters] for harbor seals and 20 feet [6 meters] for other pinnipeds). The areas encompassed by these threshold distances are shown in Table 3.4–12.

**Table 3.4–12. Calculated Maximum Distances in Air to Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Noise Thresholds, LWI Alternative 3**

| Affected Area | Impact Behavioral Harassment Harbor Seal (90 dB RMS)[1] | Impact Behavioral Harassment Other Pinnipeds (100 dB RMS)[1] | Vibratory Behavioral Harassment Harbor Seal (90 dB RMS)[1] | Vibratory Behavioral Harassment Other Pinnipeds (100 dB RMS)[1] |
|---|---|---|---|---|
| Distance to Threshold[1] | 413 ft (126 m) | 131 ft (40 m) | 59 ft (18 m) | 20 ft (6 m) |
| Area Encompassed by Threshold | North: 264,814 sq ft (24,602 sq m) South: 284,921 sq ft (26,470 sq m) | North: 27,222 sq ft (2,529 sq m) South: 28,298 sq ft (2,629 sq m) | North: 5,597 sq ft (520 sq m) South: 5,716 sq ft (531 sq m) | North: 646 sq ft (60 sq m) South: 624 sq ft (58 sq m) |

dB = decibel; ft = feet; m = meter; sq ft = square feet; sq m = square meter; RMS = root mean square

1. Sound pressure levels used for calculations were 112 dB RMS re 20 μPa at 50 feet (15 meters) (Section 3.9.3.2.2) for impact hammer for 36-inch steel pile, and 95 dB RMS re 20 μPa at 50 feet for vibratory driver for 36-inch steel pile. All distances are calculated over water.

A representative view of areas within the ZOIs for behavioral harassment due to airborne pile driving noise is shown in Figure 3.4–3. The distance between the south LWI project site and sea lion haul-out sites at Delta Pier is 1,000 feet (300 meters) and the distance between the north LWI project site and haul-out sites is 1 mile (1.6 kilometers), both of which would be beyond the airborne behavioral harassment threshold for sea lions. Sea lions that are hauled out in the vicinity of Delta Pier are not expected to be exposed to airborne pile driving noise under Alternative 3, but animals swimming within the threshold areas may be susceptible to airborne noise disturbance. Given the small size of the ZOIs for airborne pile driving noise and their locations in areas that are not frequented by sea lions, no exposures to above-threshold airborne noise levels are predicted for these species. The density-based noise exposure formula described in Section 3.4.2.2.2 for harbor seals, which regularly swim in but rarely haul out in the project area, predicts no exposures to above-threshold airborne noise levels. Therefore, no MMPA exposures due to airborne pile driving noise under Alternative 3 are expected.

Airborne sound due to other construction equipment would be similar to the levels described for non-pile driving construction noise under Alternative 2 in Section 3.4.2.2.2. Average noise levels are expected to be in the 60 to 68 A-weighted dBA range, consistent with urbanized or industrial environments where equipment is operating and similar to the range of noise measured on Delta Pier (Navy 2010). Operation of non-pile driving, heavy construction equipment would produce airborne noise levels ranging from 78 to 90 dBA at 50 feet (15 meters) (WSDOT 2013). In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet (Section 3.9), but this noise level would be occasional. Because noise levels produced by non-piling driving equipment are lower than noise levels produced by pile drivers, no MMPA take is expected from the operation of other construction equipment.

OPERATION/LONG-TERM IMPACTS FOR LWI ALTERNATIVE 3

LWI Alternative 3 would modify the existing PSB system to extend across the intertidal zone and attach to concrete abutments at the shoreline, and the pile-supported pier and mesh proposed under Alternative 2 would not be constructed. Thus, no barrier to movement of marine biota would occur under Alternative 3. The potential long-term effects on the prey base due to habitat loss and degradation (discussed in Section 3.4.2.2.3) would be less significant compared to impacts from Alternative 2. Alternative 3 would permanently displace a small amount of benthic habitat (0.0033 acre [0.0013 hectare]) compared with the displacement of 0.14 acre (0.06 hectare) under Alternative 2, with a corresponding loss of habitat suitability and productivity of some prey species (Table 3.2–8). In addition to the project footprint, some PSB units and buoys would regularly ground out on the seafloor at low tide under Alternative 3, resulting in a net reduction in functional value of a small area of nearshore habitat (approximately 0.06 acre [0.024 hectare]) used by prey species. Marine mammals are wide-ranging and have extensive foraging habitat available in Hood Canal, relative to the foraging area that might be impacted by operation of the LWI. Similar to Alternative 2, localized changes in prey availability are possible under Alternative 3, but impacts cannot be quantified with available information and are expected to be insignificant. The Mitigation Action Plan (Appendix C) describes the marine habitat mitigation that the Navy would undertake as part of the Proposed Action. This habitat mitigation would compensate for impacts of the Proposed Action on marine habitats and species and which, consequently, might indirectly affect the marine mammal prey base.

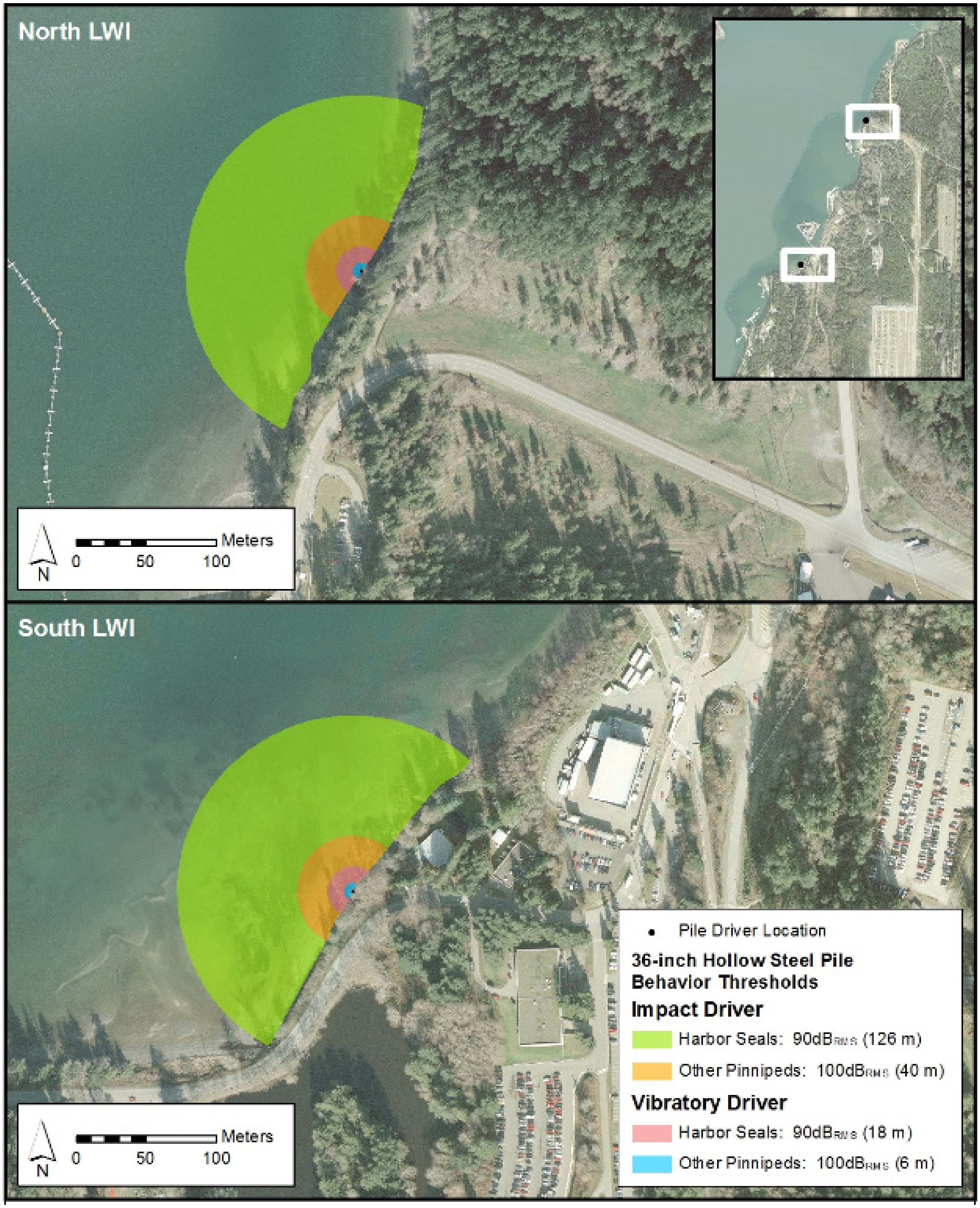


**Figure 3.4–3. Representative View of Affected Areas for Marine Mammals due to Airborne Pile Driving Noise during Construction of LWI Alternative 3**

Operation and maintenance of the LWI under Alternative 3 would include increased noise and visual disturbance from human activity and artificial lighting used during security operations. However, disturbance levels would not be appreciably higher than existing levels elsewhere at the Bangor waterfront, to which marine mammals appear to have habituated. Because LWI lighting would be used only during security responses, use of artificial lighting at the LWI is expected to have a negligible impact on fish species preyed on by marine mammals, as described in Section 3.3.2.2.3. Pontoons of the PSB may be used by California sea lions as haul-outs, but the south and north shoreline abutments would not be accessible for hauling out. In conclusion, direct and indirect effects of project operations on marine mammals would be negligible, and no MMPA take is expected.

#### 3.4.2.2.4. Summary of Impacts for LWI Project Alternatives

Impacts on marine mammals during the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.4–13.

**Table 3.4–13. Summary of LWI Impacts on Marine Mammals**

| Alternative | Environmental Impacts on Marine Mammals |
|---|---|
| LWI Alternative 1: No Action | No impact. |
| LWI Alternative 2: Pile-Supported Pier | *Construction:* Direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability due to installation of pile-supported pier. Construction noise (primarily due to pile driving) sufficient to exceed NMFS disturbance thresholds. Construction disturbance due to in-water work would occur over two seasons, including a total of 80 days of in-water and land-based pile driving during one in-water work season.<br>*Operation/Long-term Impacts:* Indirect impacts on prey species due to loss and degradation of benthic habitat, and barriers to migratory fish. |
| | *MMPA:* The Proposed Action would expose marine mammal species in the area to noise levels that would result in behavioral disturbance due to underwater vibratory pile driving. No injurious exposures to noise are expected due to the use of vibratory pile driving as the primary pile installation method, the small size of the injury zone from impact pile driving, and monitoring of the injury zone so that a shutdown would occur if a marine mammal approaches the zone.<br>*ESA:* Effect determination for the humpback whale (based on infrequent occurrence) and Southern Resident killer whale is "may affect, not likely to adversely affect"; and "no effect" on Southern Resident killer whale critical habitat. |
| LWI Alternative 3: PSB Modifications (Preferred) | *Construction:* Direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability, construction noise (primarily due to pile driving) not sufficient to exceed NMFS disturbance thresholds. Construction disturbance due to in-water work would occur over one season. Airborne noise from land-based pile driving up to 30 days. No in-water pile driving would occur.<br>*Operation/Long-term Impacts:* Indirect impacts on prey species due to loss and degradation of benthic habitat, but minor barriers to migratory fish, in contrast to Alternative 2. Potentially additional haul-out opportunities for pinnipeds on additional PSB pontoons. |
| | *MMPA:* No exposure to injury or behavioral disturbance due to airborne pile driving noise is expected based on distance from sea lion haul-out locations, the small size of the disturbance zones, and low density of harbor seals.<br>*ESA:* Effect determination for the humpback whale (based on infrequent occurrence) and Southern Resident killer whale is "may affect, not likely to adversely affect"; and "no effect" on Southern Resident killer whale critical habitat. |

**Table 3.3-13. Summary of LWI Impacts on Marine Mammals (continued)**

| Alternative | Environmental Impacts on Marine Mammals |
|---|---|
| **Mitigation:** Marine mammals would be monitored during all in-water pile installation activities of the LWI project, and shutdown procedures would be implemented if any marine mammal enters the injury threshold zone for pile driving. Please see Appendix C (Mitigation Action Plan) for more detailed mitigation measures. A detailed marine mammal monitoring plan would be developed in consultation with NMFS. | |
| **Consultation and Permit Status**<br>The Navy consulted with the NMFS West Coast Region Office on the humpback whale and Southern Resident killer whale under the ESA and submitted a Biological Assessment on March 10, 2015, and a revised Biological Assessment on June 10, 2015. NMFS issued a Letter of Concurrence on November 13, 2015, concurring with the Navy's effect determinations for Alternative 3. The Navy did not request an authorization under the Marine Mammal Protection Act for the LWI Preferred Alternative 3 because the Proposed Action does not include in-water pile driving. | |

ESA = Endangered Species Act; IHA = Incidental Harassment Authorization; MMPA = Marine Mammal Protection Act; NMFS = National Marine Fisheries Service

### 3.4.2.3. SPE PROJECT ALTERNATIVES

#### 3.4.2.3.1. SPE ALTERNATIVE 1: NO ACTION

There would be no activities related to construction or operations that would disturb marine mammals in the project area under the No Action Alternative. Therefore, this alternative would have no impacts on marine mammals.

#### 3.4.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

Construction of the SPE would directly impact marine mammals, primarily through underwater noise generated by pile driving. Underwater noise thresholds for behavioral disturbance would be exceeded, as described below, with potential adverse impacts (takes) as defined by the MMPA. Project-related changes in water quality, vessel traffic, and prey availability may also affect marine mammals indirectly or directly.

Long-term indirect impacts would result from localized changes in benthic prey population composition and vegetation (Section 3.2), which could affect marine fish populations (Section 3.3) and, consequently, marine mammals that prey on fish. Impacts on marine mammals from operation of this alternative are anticipated to be highly localized because marine mammals are wide-ranging and have a large foraging habitat available in Hood Canal, relative to the foraging area that might be impacted by operation of the LWI.

##### CONSTRUCTION OF SPE ALTERNATIVE 2

The primary impacts on marine mammals from construction of SPE Alternative 2 would include water quality changes (turbidity) in nearshore habitats, construction vessel traffic, changes in prey availability, and noise associated with impact and vibratory pile driving and other construction equipment. Since harbor seals are resident in Hood Canal, they would be present during the entire proposed construction season for the SPE (July 15 through January 15). Harbor porpoise and transient killer whales also may occur at any time during the year. California sea lions are present year round with minimal numbers occurring June through August, and Steller sea lions are present during fall through winter months (about 4 months out of the 6 months of in-water construction work). Marine mammals are likely to avoid (indicating behavioral disturbance) the vicinity of pile driving. The likelihood of adverse impacts on these species would be minimized through application of mitigation measures described in the Mitigation Action Plan (Appendix C).

*WATER QUALITY*

Construction of the SPE would affect water quality in project area waters due to anchoring of barges and tugs, installation of piles, and work vessel movement, as described in Section 3.1.2.3.2. The majority of impacts are expected to occur within the construction corridor surrounding pile locations (100 feet [30 meters]). A maximum of 3.9 acres (1.6 hectares) of bottom sediment may be disturbed within the construction footprint. Resuspended sediments would increase turbidity during in-water construction activities, but turbidity would be localized and temporary during the course of project construction, as discussed in Section 3.1.2.3.2. Metals and organic contaminants that may be present in sediments could also become suspended in the water column in the construction impact zone, but these contaminants are within sediment quality guidelines, as discussed in Section 3.1.1.1.3. Water quality could also be affected by stormwater discharges (contaminant loading), and spills (contaminant releases). However, construction-period conditions are not expected to exceed water quality standards, and measures for the protection of marine water quality and the seafloor would be implemented to minimize impacts (Mitigation Action Plan, Appendix C). Therefore, no impacts on marine mammals are expected due to changes in water quality during construction.

*VESSEL TRAFFIC*

Marine mammals at NAVBASE Kitsap Bangor encounter vessel traffic associated with daily operations, maintenance, and security monitoring along the waterfront, and it appears that individuals that frequent the waterfront have habituated to existing levels of vessel activity. During construction of the SPE, several additional vessels would operate in the project area. Construction activity involving vessel traffic may occur over 24 months, but the greatest activity levels would be associated with pile driving (up to 161 days during two in-water work seasons). Approximately six round trip barge and tug transits per month are expected for the duration of the project (Table 2–2). These vessels would operate at low speeds within the relatively limited construction zone and access routes during the in-water construction period. Low speeds are expected to reduce the impact of boat movements in the construction zone during this period. Marine vessel traffic would potentially pass near marine mammals on an incidental basis, but short-term behavioral reactions to vessels are not expected to result in long-term impacts on individuals, such as chronic stress, or to marine mammal populations in Hood Canal.

Collisions of vessels and marine mammals, primarily cetaceans, are not expected during construction because vessel speeds would be low. All of the cetaceans likely to be present in the project area are fast-moving odontocete species that tend to surface at relatively short, regular intervals allowing for increased detectability and avoidance. Vessel impacts are more frequently documented for slower-moving cetaceans or those that spend extended periods of time at the surface, but these species are rarely encountered in Hood Canal.

*PREY AVAILABILITY*

The prey base for the most common marine mammal species (harbor seal and California sea lion) in the project area potentially includes a wide variety of fishes including Pacific hake, forage fish such as Pacific herring, adult and juvenile salmonids, flatfish, and other finfish. Steller sea lions in the project area probably also consume a variety of pelagic and bottom fish. Harbor porpoise are occasionally seen in Hood Canal, where they probably feed on schooling forage fishes, such as Pacific herring, smelt, and squid. Transient killer whales consume marine mammals; in Hood Canal they preyed on harbor seals during prolonged stays in 2003 and 2005 (London 2006). Southern Resident killer whales do not occur in Hood Canal, but consume adult salmonids (with a strong preference for Chinook and chum salmon) that may originate in Hood Canal tributaries.

As described in Section 3.3.1.1, fish species and groups that occur in the deeper-water SPE project area include some forage fish (e.g., Pacific sand lance and Pacific herring) and salmonids (juvenile Chinook salmon, coho salmon, and steelhead; adult/sub-adult Chinook salmon, steelhead; and cutthroat trout) (Bhuthimethee et al. 2009). Other marine fish species likely are not abundant or diverse at the SPE project site. Benthic organisms are likely not as abundant at the SPE project site since it is located in waters deeper than 30 feet (9 meters) below MLLW, and the adjacent nearshore appears to support less diversity than the SPE project sites. The project site portion of the Bangor shoreline has a steep subtidal grade, lacks a flat bottom benthic habitat, and has no nearby freshwater nutrient input. These deeper-water resources offer suitable prey for some of the marine mammals that have been documented in Hood Canal and the Bangor waterfront, but available information is not sufficiently detailed to support a comparison of the SPE project site with other known or potential foraging sites in inland waters.

The greatest impacts on prey species during construction of the SPE project would result from resuspension of sediments, localized turbidity, and behavioral disturbance due to pile driving noise, as described in Section 3.3.2.3.2. Injury and behavioral disturbance of fish species due to underwater pile driving noise would directly affect the prey base for marine mammals. For SPE Alternative 2, fish potentially would be disturbed by pile driving noise resulting from operation of vibratory and impact rigs within 8,242 feet (2,512 meters) of impact pile driving noise and 384 feet (117 meters) of vibratory pile installation (Section 3.3.2.3.2), but may actually avoid a much smaller area. Thus, prey availability within an undetermined portion of the impact zone for fish would be reduced during construction due to noise. Mitigation measures designed to minimize noise effects on fish are described in the Mitigation Action Plan (Appendix C).

Some of the effects described above, such as barge placement, increased turbidity, and pile driving noise, would occur only during the in-water construction period and thus would be temporary (up to 6 months) and localized within the fish behavioral harassment zone. Long-term effects on prey availability are described below under Operation/Long-term Impacts. While localized effects of project construction may affect the prey base of pinnipeds that occur in the project vicinity, in the overall context of the Hood Canal harbor seal and California sea lion populations, the affected area is too small to represent a significant adverse impact.

With respect to the ESA-listed Southern Resident killer whale, the project has the potential to affect this population by indirectly affecting its prey base, which includes a disproportionate number of adult Chinook and chum salmon (Ford et al. 1998, 2010; Hanson et al. 2010; Hanson 2011). Available information on the proportion of Hood Canal Chinook salmon in the diet of Southern Resident killer whales indicates that it is about 20.4 percent in May (however, this is based on a sample size of only nine), but is less than 5 percent in other months (June to September) for which data are available. The stock identification of chum salmon in Southern Resident killer whale diets has not been reported and therefore the importance of Hood Canal chum salmon is unknown. Adult Hood Canal Chinook and chum salmon returns are subject to many variables (Section 3.3), among which the effects of the SPE are likely to be minor. Mitigation efforts, including scheduling in-water construction for the period when juvenile Chinook salmon are not present and using a bubble curtain for impact pile driving, would minimize this potential adverse effect. Therefore, the project's effect on Southern Resident killer whale prey base would be minimal. The ESA effect determination for construction activities under SPE Alternative 2 is "may affect, not likely to adversely affect" Southern Resident killer whales. The project would have no effect on critical habitat for Southern Resident killer whales because no critical habitat has been designated in Hood Canal.

*UNDERWATER NOISE*

Average underwater noise levels measured along the Bangor waterfront are elevated over ambient conditions at undeveloped sites due to waterfront operations, but are within the minimum and maximum range of measurements taken at similar environments within Puget Sound (see Appendix D). In 2009, the average broadband ambient underwater noise levels were measured at 114 dB re 1 μPa between 100 Hz and 20 kHz (Slater 2009). Peak spectral noise from industrial activity was below the 300 Hz frequency, with maximum levels of 110 dB re 1 μPa noted in the 125 Hz band. In the 300 Hz to 5 kHz range, average levels ranged between 83 and 99 dB re 1 μPa. Wind-driven wave noise dominated the background noise environment at approximately 5 kHz and above, and ambient noise levels flattened above 10 kHz. Underwater ambient noise measurements taken approximately 1.85 miles (3 kilometers) from the project area at EHW-1, during the TPP project in 2011, ranged from 112.4 dB re 1 μPa RMS between 50 Hz and 20 kHz at mid depth to 114.3 dB at deep depth (Illingworth & Rodkin 2012).

Increased vessel activity and barge-mounted construction equipment such as cranes and generators would elevate underwater noise levels in the project area. Noise from tugs associated with barge movement would produce intermittent noise levels of approximately 142 dB re 1 μPa at 33 feet (10 meters). Except at very close range, these noise sources and noise from other vessels and equipment would not exceed marine mammal thresholds for disturbance due to impact sound (160 dB RMS). These noise levels are typical of an industrial waterfront where tugs, barges, and other vessels are in operation, and consistent with noise levels experienced daily by marine mammals under existing conditions in the vicinity of the Bangor waterfront. Vessel noise includes narrowband tones at specific frequencies and broadband sounds, with energy spread over a range of frequencies that are audible to marine mammals. Smaller vessels that would be used in construction tend to generate low-frequency noise below 5 kHz. For example, tugs operating barges generate sounds from 1 kHz to 5 kHz, and small crewboats generate strong tones up to several hundred hertz (Richardson et al. 1995).

Underwater noise associated with impact and vibratory pile driving is likely to cause the most significant impacts on marine mammals present during construction of the SPE. Detailed analyses of pile driving noise propagation and pile driving source levels are presented in Appendix D, along with a discussion of the use of a bubble curtain to attenuate impact pile driving noise of steel piles. SPE Alternative 2 would require installation of 230 36-inch (90-centimeter) steel pipes, 50 24-inch (60-centimeter) steel piles, and 105 18-inch (45-centimeter) concrete fender piles over two in-water work seasons including comprising 125 days of driving steel support piles and 36 days of driving concrete fender piles. Most steel piles would be driven with a vibratory driver, and an impact hammer would be used to “proof” these piles. In cases where substrate conditions do not allow vibratory installation, an impact hammer may be needed to drive piles for part or all of their length.

Vibratory pile driving of 36-inch (90-centimeter) steel piles would produce noise levels of approximately 166 dB RMS re 1 µPa at 33 feet (10 meters) from the pile. Impact pile driving of 36-inch steel piles using a single-acting diesel impact hammer would produce average RMS noise levels of 186 dB RMS re 1 µPa at 33 feet, while using a bubble curtain that reduces noise levels by 8 dB. Vibratory pile driving of 24-inch (60-centimeter) steel piles would produce noise levels of approximately 161 dB RMS re 1 µPa at 33 feet from the pile. Impact pile driving of 24-inch steel piles using a single-acting diesel impact hammer would produce average RMS noise levels of 185 dB RMS re 1 µPa at 33 feet, while using a bubble curtain that reduces noise levels by 8 dB. Other mitigation measures, including a soft-start approach for pile driving operations and marine mammal monitoring and shutdown zones during pile driving, are described in the Mitigation Action Plan (Appendix C). The project would also require pile driving of 18-inch (45-centimeter) square concrete piles. The source level for this pile driving is 170 dB RMS re 1 µPa at 33 feet (Appendix D). All of the concrete piles would be installed with an impact hammer. A bubble curtain would not be used for installation of concrete piles because the source level at 33 feet (10 meters) is lower than the injury impact thresholds for marine mammals (180 dB RMS for cetaceans and 190 dB RMS for pinnipeds) (Table 3.4–14). Most of the energy in pile driving sound underwater is contained in the frequency range 25 Hz and 1.6 kHz, with the highest energy densities between 50 and 350 Hz (Reyff et al. 2002). In some studies, underwater pile driving noise has been reported to range up to 10 kHz with peak amplitude below 600 Hz (Laughlin 2005).

Sound from impact pile driving would be detected above the average background noise levels at locations in Hood Canal with a direct acoustic path (i.e., line-of-sight from the driven piles to receiver location). Intervening land masses would block sound propagation outside of direct paths.

*Responses to Underwater Pile Driving Noise at the SPE Project Sites*

Marine mammals encountering pile driving operations during the in-water construction season would likely avoid affected areas in which they experience noise-related discomfort, limiting their ability to forage or rest there. Individual responses to pile driving noise are expected to be variable. For example, some individuals may occupy the project area during pile driving without apparent discomfort, but others may be displaced by undetermined long-term effects. Avoidance of the affected area during pile driving operations would reduce the likelihood of injury impacts but also would reduce access to foraging areas in nearshore and deeper waters of Hood Canal. Noise-related disturbance across the 1.5-mile (2.4-kilometer) width of Hood Canal may inhibit some marine mammals from transiting the area. During pile driving over the two in-water construction season, there is a potential for displacement of marine mammals from the affected area due to these behavioral disturbances during the in-water construction season. However, habituation may occur over time, along with a decrease in the severity of responses. Also, since pile driving would only occur during daylight hours, marine mammals transiting the project area or foraging or resting in the project area at night would not be affected. Any potential impacts from pile driving activities could be experienced by individual marine mammals, but would not cause population level impacts or affect the continued survival of the species.

*Underwater Injury and Behavioral Harassment Thresholds*

The following analysis of noise-related impacts on marine mammals provides calculations of incidental harassment exposures of all marine mammal species that occur in the SPE project area, as required by the MMPA. "Take" under the MMPA is calculated at two levels, injury exposure and behavioral harassment exposure. The effects analysis uses the terms "injury exposure" and "behavioral harassment exposure" for MMPA effects and states the number of exposures that the Navy will request for each marine mammal species in its IHA applications. NMFS identified threshold criteria for determining injury exposure to underwater noise as 190 dB RMS re 1 µPa for pinnipeds and 180 dB RMS re 1 µPa for cetaceans (65 FR 16374-16379) (Table 3.4–14). Injury exposure criteria have been used by NMFS to define the impact zones for seismic surveys and impact hammer pile driving projects, within which project activities may be shut down if protected marine mammals are present (e.g., examples cited in 71 FR 4352, 71 FR 6041, 71 FR 3260, and 65 FR 16374). NMFS has identified different thresholds for exposure to behavioral harassment for impact pile driving (an impulsive noise impact) versus vibratory pile driving (a continuous noise impact). For both cetaceans and pinnipeds, the behavioral harassment threshold for impact pile driving is 160 dB RMS re 1 µPa, and the threshold for continuous noise such as vibratory pile driving is 120 dB RMS re 1 µPa.

**Table 3.4–14. Current Marine Mammal Injury and Behavioral Harassment Thresholds for Underwater and Airborne Sounds**

| Marine Mammals | Airborne Marine Construction Thresholds (Impact and Vibratory Pile Driving) (dB re 20 µPa unweighted) | Underwater Vibratory Pile Driving[2] Threshold (dB re 1 µPa) | | Underwater Impact Pile Driving[3] Thresholds (dB re 1 µPa) | |
|---|---|---|---|---|---|
| | Disturbance Guideline Threshold[1] | Injury Threshold | Behavioral Harassment Threshold | Injury Threshold | Behavioral Harassment Threshold |
| Cetaceans (whales, dolphins, porpoises) | N/A | 180 dB RMS | 120 dB RMS | 180 dB RMS | 160 dB RMS |
| Pinnipeds (sea lions and seals, except harbor seal) | 100 dB RMS | 190 dB RMS | 120 dB RMS | 190 dB RMS | 160 dB RMS |
| Harbor seal | 90 dB RMS | 190 dB RMS | 120 dB RMS | 190 dB RMS | 160 dB RMS |

dB = decibel; µPa = micropascal; N/A = not applicable, no established threshold; RMS = root mean square

1. Sound level at which pinniped haul-out disturbance has been documented. Not an official threshold, but used as a guideline.
2. Non-pulsed, continuous sound.
3. Impulsive sound.

NOAA (2015) has recently developed draft acoustic threshold levels for determining the onset of PTS and TTS (permanent and temporary hearing threshold shifts, respectively) in marine mammals in response to underwater impulsive and non-impulsive sound sources. The draft criteria use cumulative SEL metrics (dB $SEL_{CUM}$) and peak pressure (dB peak) rather than the currently used dB RMS metric. NOAA equates the onset of PTS, which is a form of auditory injury, with Level A harassment under the MMPA and "harm" under the ESA. The onset of TTS would be a form of Level B harassment under the MMPA and "harassment" under the ESA. Both forms of harassment would constitute "take" under these statutes. The draft injury criteria are currently in public review and have not been finalized. Revised behavioral harassment criteria not involving TTS (but resulting in Level B take) are currently in review. If the new injury criteria are adopted by NOAA prior to the completion of the ROD for the project, the noise effects analysis for marine mammals would be updated. Otherwise, the noise analysis would not be updated.

With a properly functioning bubble curtain in place on the impact hammer rig, construction of SPE Alternative 2 would likely result in noise-related injury to pinnipeds and cetaceans within 16 feet (5 meters) and 82 feet (25 meters) from a driven pile, respectively (Table 3.4–15). Injury exposure to intense underwater noise could consist of PTS or other tissue damage. However, marine mammals are unlikely to be injured by pile driving noise at these short distances because the high level of human activity and vessel traffic would cause them to avoid the immediate construction area. Cetaceans in particular are unlikely to swim this close to manmade structures. In addition, marine mammal monitoring during construction (Mitigation Action Plan, Appendix C, Section 4.2) would preclude exposure to injury from pile driving noise.

No physiological impacts are expected from pile driving operations during construction of the SPE for the following reasons. First, vibratory pile driving, which would be the primary installation method, does not generate high enough peak sound pressure levels to produce physiological damage. For SPE Alternative 2, the primary method of installation for the 24- and 36-inch (60-and 90-centimeter) steel piles would be vibratory driving. An impact hammer would be utilized to "proof" piles if needed; proofing a steel pile is assumed to require no more than 200 strikes of the impact hammer. Square concrete piles would be driven with an impact hammer only and require no more than 300 strikes per pile. Thus, under the worst-case scenario, marine mammals in the vicinity of the SPE project sites would experience elevated noise levels for only a portion of the day. Additionally, the bubble curtains that the Navy would employ during impact pile driving (Appendix D) would greatly reduce the chance that a marine mammal may be exposed to sound pressure levels that could cause physical harm. During impact pile driving, the Navy would employ a bubble curtain to attenuate initial sound pressure level. Moreover, the Navy would have trained biologists monitoring a shutdown zone equivalent to the potential physiological injury zone (Mitigation Action Plan, Appendix C) to preclude the potential for injury of marine mammals.

The areas encompassed by these threshold distances within the SPE Alternative 2 project area are shown in Table 3.4–15, and a representative scenario of areas affected by above-threshold noise levels is shown in Figure 3.4-4. The representative areas in Figure 3.4–4 depict effects related to operation of a pile driver at one location at the seaward end of the SPE, but pile driving would occur along the entire length of the pier during the course of project construction. Only one impact pile driver would operate at a time. Table 3.4–15 shows the ZOIs affected by pile driving at this representative location. Placement of pile driving rigs at other locations along the SPE alignment would generate above-threshold noise levels in slightly different areas.

**Table 3.4–15. Calculated Maximum Distance(s) to the Underwater Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Current Noise Thresholds, SPE Alternative 2**

| Affected Area | Impact Injury Pinnipeds (190 dB RMS)[1] | Impact Injury Cetaceans (180 dB RMS)[1] | Impact Behavioral Harassment Cetaceans & Pinnipeds (160 dB RMS)[1] | Vibratory Behavioral Harassment Cetaceans & Pinnipeds (120 dB RMS)[2] |
|---|---|---|---|---|
| **36-inch (90-centimeter) Steel Piles** | | | | |
| Distance to Threshold[1] | 16 ft (5 m) | 82 ft (25 m) | 1,775 ft (541 m) | 7.2 mi (11.7 km) |
| Area Encompassed by Threshold | 850 sq ft (79 sq m) | 21,022 sq ft (1,953 sq m) | 0.30 sq mi (0.77 sq km) | 19.3 sq mi[2] (50.1 sq km) |
| **24-inch (60-centimeter) Steel Piles** | | | | |
| Distance to Threshold[1] | 16 ft (5 m) | 72 ft (22 m) | 1,522 ft (464 m) | 3.4 mi (5.4 km) |
| Area Encompassed by Threshold | 850 sq ft (79 sq m) | 16,372 sq ft (1,521 sq m) | 0.21 sq mi (0.53 sq km) | 9.6 sq mi[2] (24.8 sq km) |
| **18-inch (45-centimeter) Concrete Piles** | | | | |
| Distance to Threshold[3] | <2 ft (<1 m) | 7 ft (2 m) | 151 ft (46 m) | N/A |
| Area Encompassed by Threshold | Negligible | Negligible | 0.003 sq mi (0.007 sq km) | N/A |

dB = decibel; ft = feet; m = meter; RMS = root mean square; sq ft = square feet; sq km = square kilometer; sq m = square meter; sq mi = square mile

1. Bubble curtain assumed to achieve 8 dB reduction in sound pressure levels during impact pile driving. Sound pressure levels used for calculations were: 186 dB re 1 μPa at 33 feet (10 meters) for impact hammer with bubble curtain and 166 dB re 1 μPa for vibratory driver for 36-inch (90-centimeter), hollow steel pile. All sound levels are expressed in dB RMS re 1 μPa.
2. Calculated area is greater than actual sound propagation through Hood Canal due to intervening land masses. Thus 7.2 miles (11.7 kilometers) is the greatest line-of-sight distance from pile driving locations unimpeded by land masses.
3. Sound pressure levels used for calculations were 170 dB re 1 μPa at 33 feet (10 meters) for impact hammer without bubble curtain.

Behavioral disturbance due to impact pile driving is calculated at approximately 1,775 feet (541 meters) from the driven pile, resulting in an affected area of approximately 0.30 square mile (0.77 square kilometer) around the driven pile. Marine mammals within this area would be susceptible to behavioral harassment during impact pile driving operations. The calculated distance for the behavioral harassment threshold due to vibratory installation is approximately 7.2 miles (11.7 kilometers), but intervening land masses would truncate the propagation of underwater pile driving sound from a driven pile (Figure 3.4–4). The area encompassed by the truncated threshold distance is approximately 19.3 square miles (50.1 square kilometers) around the pile drivers (Figure 3.4–4). Marine mammals within this area would be susceptible to behavioral harassment due to vibratory pile driving operations.

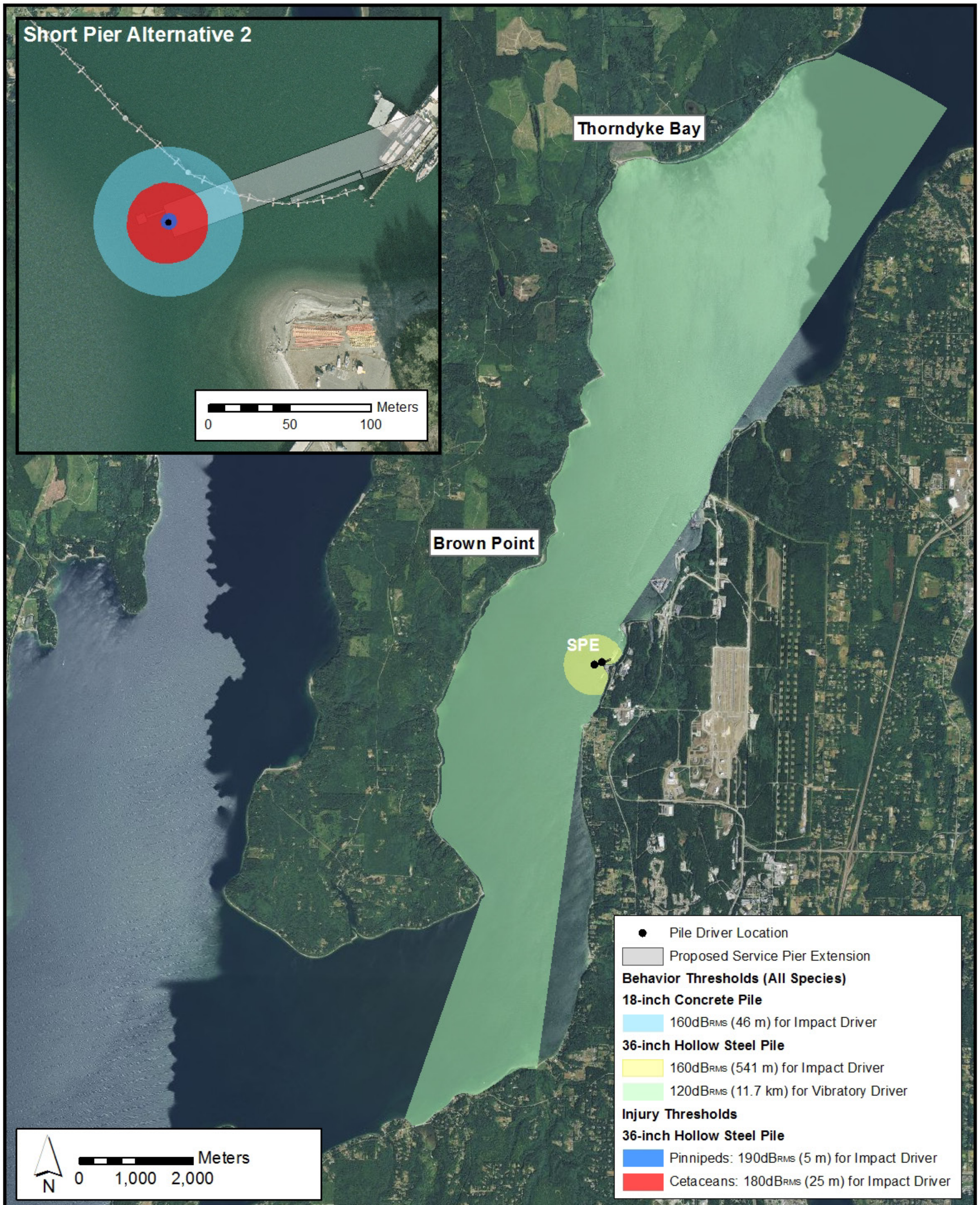


**Figure 3.4-4. Representative View of Affected Areas for Marine Mammals due to Underwater Pile Driving Noise during Construction of SPE Alternative 2**

As described in Section 3.4.1.2.2, behavioral responses of marine mammals to underwater noise are variable and context-specific. Some individuals may habituate to the elevated construction noise levels and continue to use the affected area, while other animals may avoid the area or respond by modifying feeding or resting behaviors. Temporary loss of hearing sensitivity in marine mammals (TTS) is a possible outcome of exposure to intense underwater noise that would be considered a form of behavioral harassment, as TTS is considered to be physiological fatigue rather than injury (Popper et al. 2006). Notwithstanding, TTS is an undesirable outcome of noise exposure because it can potentially affect communication and/or the ability to detect predators or prey. Behavioral harassment can also be indicated by actions such as avoidance of the construction area, changes in travel patterns, diving behavior, respiration, or feeding behavior.

*AIRBORNE NOISE*

Construction of SPE Alternative 2 would result in increased airborne noise in the vicinity of the construction site, as discussed in Section 3.9.3.3. The highest noise source levels would be associated with impact pile driving (230 36-inch [90-centimeter] steel pipes, 50 24-inch [60-centimeter] steel support piles and 105 18-inch [45-centimeter] concrete fender piles). The worst-case pile driving source level (for 36-inch steel piles) is estimated to be 112 dB RMS re 20 μPa (unweighted) at 50 feet (15 meters) from the pile for an impact hammer, and 95 dB RMS re 20 μPa (unweighted) at 50 feet from the pile for vibratory pile driving (Section 3.9.3.3.2).

The dominant airborne noise frequencies produced by pile driving are between 50 and 1,000 Hz (WSDOT 2013). No airborne source levels were available for 18-inch concrete pile. Modeled distances to airborne thresholds would likely be considerably smaller for concrete piles than for steel piles.

Airborne noise would primarily be an issue for pinnipeds that are swimming or hauled out in the project area. Mitigation measures for pile driving noise, including a soft-start approach to pile driving operations and marine mammal monitoring, are described in the Mitigation Action Plan (Appendix C).

In addition to pile driving, other SPE construction activities and equipment would generate lower noise levels that are comparable to ambient levels elsewhere along the NAVBASE Kitsap Bangor waterfront where ongoing operations use trucks, forklifts, cranes, and other equipment (Section 3.9.3.3). Construction equipment for the SPE project would include backhoes, bulldozers, loaders, graders, trucks, and cranes. Activities that would generate elevated noise levels could include removal of creosote timber piles, installation of a new wave screen, construction of the Pier Services and Compressor building (Figure 2–9), and other upland construction. Average noise levels are expected to be in the 60 to 68 dBA range, consistent with urbanized or industrial environments where equipment is operating and similar to the range of noise measured on Delta Pier (Navy 2010). Operation of non-pile driving, heavy construction equipment would produce airborne noise levels ranging from 78 to 90 dBA at 50 feet (15 meters) (WSDOT 2013). In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet (see Section 3.9), but this noise level would be occasional.

*Responses to Airborne Pile Driving Noise at the SPE Project Sites*

Pinnipeds have habituated to existing airborne noise levels at Delta Pier on NAVBASE Kitsap Bangor, where they regularly haul out on submarines and the pontoons supporting the PSB. Most likely, airborne sound would cause behavioral responses similar to those discussed above in relation to underwater noise. For instance, elevated airborne construction noise could cause hauled out pinnipeds to return to the water, reduce vocalizations, or cause them to temporarily abandon their usual or preferred haul-out locations and move farther from the noise source. Pinnipeds swimming in the vicinity of pile driving may avoid or withdraw from the area or show increased alertness or alarm (e.g., head out of the water and looking around).

*Airborne Sound Behavioral Harassment Thresholds*

Pile driving can generate airborne noise that could potentially result in disturbance to marine mammals (pinnipeds) that are hauled out or at the water's surface. As a result, the Navy analyzed the potential for pinnipeds hauled out or swimming at the surface near NAVBASE Kitsap Bangor to be exposed to airborne noise that could result in behavioral harassment as defined by the MMPA. There are no criteria for injury due to elevated airborne sound. NMFS has defined the airborne noise threshold for behavioral harassment for all pinnipeds except harbor seals as 100 dB RMS re 20 µPa (unweighted) (Table 3.4–14). The threshold value for harbor seals is 90 dB RMS re 20 µPa (unweighted).

Airborne impact pile driving noise for 36-inch (90-centimeter) steel piles for the SPE would likely result in behavioral harassment to harbor seals at a distance of 620 feet (189 meters) and to other pinnipeds (California sea lions and Steller sea lions) at a distance of 197 feet (60 meters) (Table 3.4–16). Vibratory pile driving noise would likely result in behavioral harassment to harbor seals at a distance of 89 feet (27 meters) and to other pinnipeds at a distance of 26 feet (8 meters) (Table 3.4–16). The areas encompassed by these threshold distances are shown in Table 3.4–16 and a representative scenario of areas affected by above-threshold airborne noise levels for an impact pile driving rig is shown in Figure 3.4–5. Other areas would be included in the above-threshold noise areas if the analysis was performed for pile driving rigs at other locations on the SPE structure.

**Table 3.4–16. Calculated Maximum Distances in Air to Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Noise Thresholds, SPE Alternative 2**

| Affected Area | Impact Behavioral Harassment Harbor Seal (90 dB RMS)[1] | Impact Behavioral Harassment Other Pinnipeds (100 dB RMS)[1] | Vibratory Behavioral Harassment Harbor Seal (90 dB RMS)[1] | Vibratory Behavioral Harassment Other Pinnipeds (100 dB RMS)[1] |
|---|---|---|---|---|
| Distance to Threshold[1] | 620 ft (189 m) | 197 ft (60 m) | 89 ft (27 m) | 26 ft (8 m) |
| Area Encompassed by Threshold | 0.04 sq mi (0.11 sq km) | 0.004 sq mi (0.011 sq km) | 24,639 sq ft (2,289 sq m) | 2,153 sq ft (201 sq m) |

dB = decibel; ft = feet; m = meter; RMS = root mean square; sq km = square kilometer; sq mi = square mile

1. Sound pressure levels used for calculations were 112 dB RMS re 20 µPa at 50 feet (15 meters) (Section 3.9.3.3.2) for impact hammer for 36-inch (90-centimeter) steel pile, and 95 dB RMS re 20 µPa at 50 feet (15 meters) for vibratory driver for 36-inch steel pile. All distances are calculated over water.

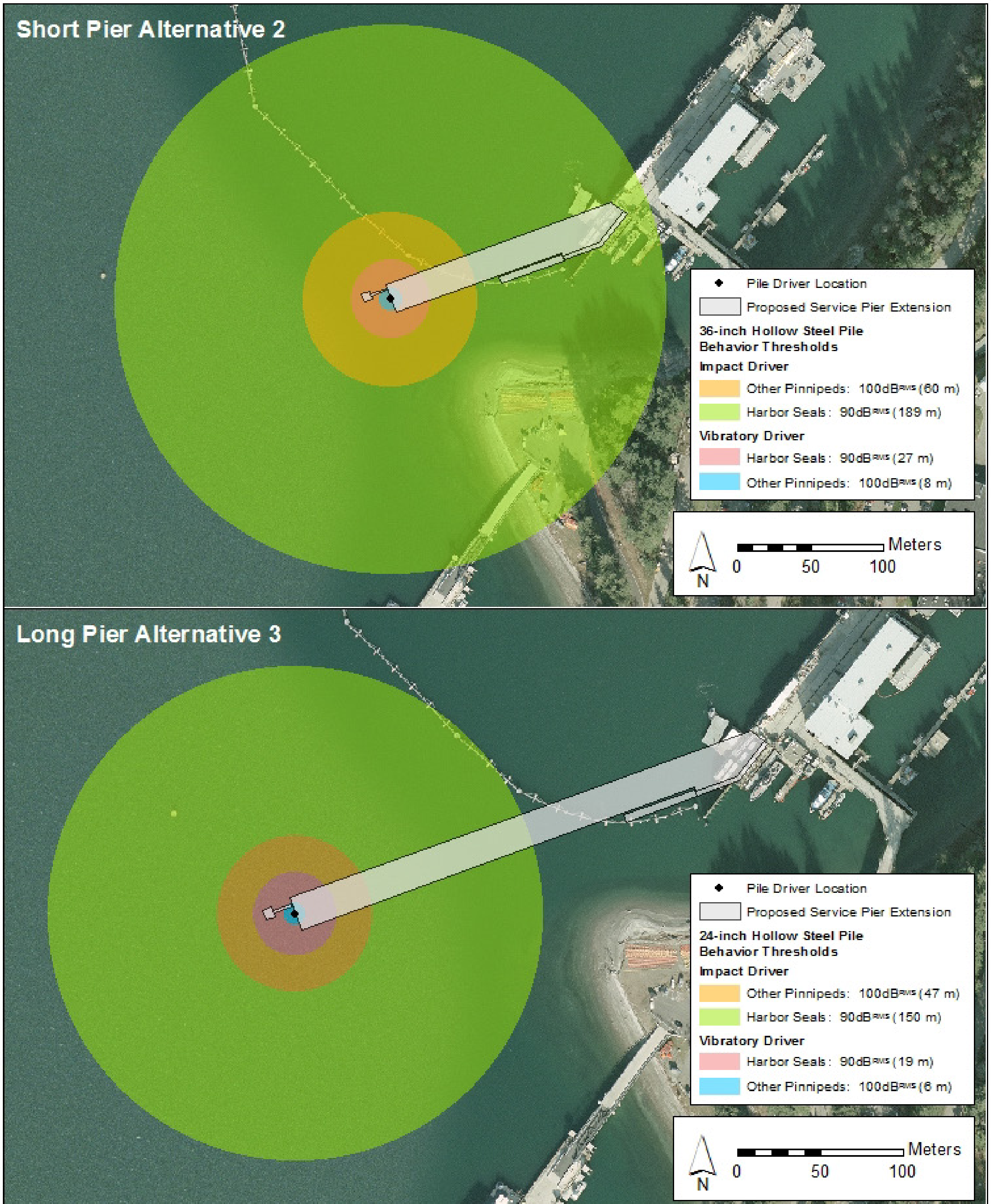


**Figure 3.4-5. Representative View of Affected Areas for Marine Mammals due to Airborne Pile Driving Noise during Construction of SPE Alternatives 2 and 3**

The distance between the SPE project site and haul-out sites at Delta Pier is 4,800 feet (1,460 meters), which is beyond the airborne behavioral harassment threshold for California sea lion and Steller sea lions. However, harbor seals were observed swimming in the project area during waterfront surveys (Tannenbaum et al. 2009a, 2011a) and may be susceptible to airborne noise disturbance resulting from pile driving. No threshold has been identified for injury to marine mammals due to airborne sound.

*CALCULATIONS OF EXPOSURE OF MARINE MAMMALS TO NOISE IMPACTS*

The analysis approach in the following section focuses on quantifying potential exposure of marine mammals to project impacts based on their density in the project area and the duration of project activities that may affect these species. The term exposure in this analysis signifies "take" under the MMPA, as detailed in Section 3.4.2.3.2, under Underwater Noise. The following species are included in the analysis because their occurrence in Hood Canal has been confirmed by specific observations during the past decade: harbor seal, California sea lion, Steller sea lion, harbor porpoise, and transient killer whale (see Section 3.4.1 for marine mammal species accounts).

*Method of Incidental Taking (MMPA)*

Pile driving activities associated with construction of the SPE, as described above, have the potential to disturb or displace marine mammals, but injury is not anticipated given the methods of installation and measures designed to minimize the possibility of injury to marine mammals. Vibratory pile drivers would be the primary method of installation, although they are not expected to cause injury to marine mammals due to the relatively low source levels (166 dB). Also, no impact pile driving of steel pile would occur without a bubble curtain, and pile driving would either not start or be halted if marine mammals approach the shutdown zone. Although the Proposed Action may affect the prey and other habitat features of marine mammals, none of these effects is expected to rise to the level of take under MMPA, as described in the following sections. The ESA-listed Southern Resident killer whale was included in the analysis of indirect effects on its prey base in Section 3.4.2.3.2, under Prey Availability, but is not carried forward in the noise effects analysis because its occurrence has not been confirmed in Hood Canal for 15 years. The humpback whale is not included in the noise effects analysis because they are rarely observed in Hood Canal, and infrequent sightings of the species has shown them occurring at the end of the in-water work window, when pile driving activities would be concluded. Therefore, no noise impacts are expected for Southern Resident killer whale or humpback whale.

*Description of Exposure Calculation*

The calculations presented here rely on the best data currently available for marine mammal population densities in Hood Canal (Navy 2013). The Navy's database (Navy Marine Species Density Database [NMSDD]) is the overarching database for all Navy projects within its operating areas. The Navy has utilized the NMSDD, in tandem with local observational data, to support several pile driving projects whose applications have been submitted to NMFS. The Northwest region's NMSDD densities were finalized in 2012. The calculations presented in this section rely on NMSDD data for harbor seals and harbor porpoises that occur in Hood Canal (Table 3.4–17). Site-specific abundance data are available from monitoring of Steller sea lions and California sea lions at NAVBASE Kitsap Bangor (see Tables 3.4–18 and 3.4–20, respectively; Navy 2015a). Transient killer whale exposure calculations are described below.

**Table 3.4–17. Marine Mammal Species Densities in Hood Canal**

| Species | Density in Hood Canal[1] animals/sq mi (animals/sq km) | Months Present in Hood Canal |
|---|---|---|
| Harbor seal[2] | 20.55 (7.93) | Year round |
| Harbor porpoise | 0.38 (0.149) | Potentially year round |

Source: Navy 2013

sq km = square kilometer; sq mi = square mile

1. Density is the largest estimate available from fall, summer, and winter estimates. Spring (March 1 through May 31) estimates were not included because the time period is outside the in-water work period.
2. Includes correction for the estimated portion of the harbor seal population that is not hauled out at a given time (London et al. 2012).

Successful implementation of mitigation measures (visual monitoring and the use of shutdown zones) would preclude injury exposures for marine mammals. However, exposures to pile driving noise would result in behavioral disturbance. Results of noise effects exposure assessments should be regarded as conservative overestimates that are influenced by limited occurrence data and the assumption that individuals may be present every day of pile driving.

The method for calculating potential exposures to impact and vibratory pile driving noise includes the following assumptions:

- Each species' population is at least as large as any previously documented highest population estimate.
- Each species would be present in the project area during construction at the start of each day, based on observed patterns of occurrence in the absence of construction. The timeframe for exposures would be 1 potential exposure per individual per 24 hours.
- All piles to be installed would have an underwater noise disturbance distance equal to the noise disturbance distance (ZOI[3]) from the pile that would cause the greatest noise disturbance (i.e., the pile farthest from shore). The underwater ZOI was calculated based on the pile driving method that produces the largest ZOI (i.e., vibratory pile driving). Although some piles would be installed with an impact hammer, the ZOI for an impact hammer would be encompassed by the larger ZOI for the vibratory driver.[4]
- In the absence of site-specific underwater acoustic propagation modeling, the practical spreading loss model was used to determine the ZOI for underwater noise.
- Some type of mitigation (i.e., bubble curtain) would be used for impact pile driving and achieve 8 dB reduction in source levels.

[3] Zone of Influence (ZOI) is the area encompassed by all locations where the sound pressure levels equal or exceed the threshold being evaluated.

[4] Although pile driving noise source levels are higher for impact-driven piles than vibratory-driven piles, the behavioral disturbance criterion for vibratory-driven piles (120 dB RMS) encompasses a much greater area than the criterion for impact-driven piles (160 dB RMS).

For species with density estimates (e.g., harbor seal, harbor porpoise), exposures are estimated by:

Exposure estimate = (n * ZOI)* X days of pile driving activity,

where:

n = density estimate used for each species/season, and
ZOI = noise threshold zone of influence (ZOI) impact area, and
X = number of days of pile driving estimated based on the total number of piles and the estimated number of piles installed per day.

The ZOI impact area is the estimated range of impact on the noise criteria thresholds for both underwater and airborne noise. The distances specified in Tables 3.4–15 and 3.4–16 were used to calculate the overwater areas that would be encompassed within the threshold distances for injury or behavioral harassment. All calculations were based on the estimated threshold ranges using a bubble curtain with 8 dB attenuation as a mitigation measure for impact pile driving. The greatest area affected by construction noise was defined as the calculated distance from SPE pile driving locations to the behavioral harassment threshold (120 dB sound pressure level), or the greatest line-of-sight distance (7.2 miles [11.7 kilometers]) that underwater sound waves could travel from pile driving locations unimpeded by land masses (Figure 3.4–4). The affected area was determined to be 19.3 square miles (50.1 square kilometers) (Table 3.4–15).

The product of n*ZOI was rounded to the nearest whole number before multiplying by the number of pile driving days. If the product of n*ZOI rounds to zero, the number of exposures calculated was zero regardless of the number of pile driving days. The exposure assessment methodology is an estimate of the numbers of individuals exposed to the effects of pile driving activities exceeding NMFS-established thresholds for underwater and airborne noise. Of significant note in these exposure estimates is that (1) implementation of one mitigation method (bubble curtain use during impact pile driving) would result in a quantifiable reduction in exposures of marine mammals to pile driving noise, (2) successful implementation of other mitigation measures such as soft starts is not reflected in exposure estimates, and (3) exposure calculations do not include Level A take because marine mammal monitoring/shutdown implementation would preclude exposure to injurious noise levels. Results from acoustic impact exposure assessments should be regarded as conservative overestimates that are strongly influenced by limited marine mammal population data.

For species with available counts of animals in the project area (Steller and California sea lions), exposures are estimated by:

Exposure estimate = (Abundance) * X days of pile driving activity,

where

Abundance = average monthly maximum counts during the months when pile driving will occur.

*SUMMARY OF PROJECT IMPACTS AND ESTIMATED EXPOSURES FOR SPECIES PRESENT IN THE SPE PROJECT AREA*

*Steller Sea Lion*

Steller sea lions are occasionally present in Washington inside waters from early fall to late spring (Jeffries et al. 2000; NMFS 2010) and have been detected in Hood Canal during the period from late September to May (Bhuthimethee 2008, personal communication; Navy 2015a; Table 3.4–18). Most detections of Steller sea lions in Hood Canal have been individuals hauled out on submarines docked at Delta Pier (Navy 2015a).

Although the Navy has determined a density for Steller sea lions in Hood Canal (Navy 2013), when more site-specific data are available it is preferable to use that data to determine the abundance of individuals that may be exposed to noise effects. This is because a density analysis assumes an even distribution of animals, whereas in reality Steller sea lion distribution within the project area is concentrated at Delta Pier. Therefore, the noise exposure calculation for Steller sea lions uses the average maximum monthly abundance of the species during the in-water work window, defined as the average of the monthly maximum number of individuals present during surveys at Delta Pier from July to January during the years 2008 through 2015. The abundance trend for Steller sea lions at Delta Pier has increased since the Navy began monitoring them in November 2008.

**Table 3.4–18. Steller Sea Lions Observed at NAVBASE Kitsap Bangor, April 2008–December 2015**

| | Maximum Number of Steller Sea Lions Observed in Single Survey | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | MAX Average |
| In-water Work Window July 15 - January 15 | July | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | August | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | September | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 1 |
| | October | 0 | 0 | 4 | 3 | 6 | 9 | 3 | 4 |
| | November | 4 | 6 | 4 | 5 | 4 | 11 | 13 | 7 |
| | December | 0 | 3 | 2 | 4 | 4 | N/A | 7 | 3 |
| | January | 0 | 2 | 1 | 3 | N/A | 1 | 6 | 2 |
| | February | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 1 |
| | March | 0 | 2 | 2 | 3 | N/A | 1 | 1 | 2 |
| | April | 0 | 4 | 6 | 4 | 0 | 2 | 1 | 2 |
| | May | 0 | 0 | 6 | 3 | 0 | 2 | 0 | 2 |
| | June | 0 | 0 | 0 | 0 | N/A | 0 | 0 | 0 |
| | **Average of in-water work window** | | | | | | | | **2** |

Source: Navy 2015a
N/A = no survey was conducted

Exposures to underwater pile driving noise were calculated using the abundance-based formula above, under Description of Exposure Calculation. Table 3.4–19 depicts the number of potential behavioral harassment exposures that are estimated from underwater vibratory and impact pile driving. Using the abundance-based analysis, the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), and an average daily abundance of approximately 2 individual Steller sea lions may experience underwater sound pressure levels that would qualify as behavioral harassment on a given day. The noise exposure formula above predicts 250 exposures to underwater noise within the behavioral harassment threshold for vibratory pile installation over the 125 days of pile driving for 36-inch (90-centimeter) steel pile. Over the 36 days of concrete pile driving, the abundance-based formula predicts an additional 72 exposures due to impact pile driving, but the potential exposures calculated this way would be an overestimate because the affected area would be very small (approximately 151 feet [46 meters] from the driven pile) and Steller sea lions would be unlikely to approach active pile driving sites at this distance.

**Table 3.4–19. Number of Potential Exposures of Marine Mammals, SPE Alternative 2**

| Species | Underwater Behavioral Harassment | | Airborne Behavioral Harassment |
|---|---|---|---|
| | Steel Piles, Vibratory Pile Driver, All Species (120 dB RMS) | Concrete Piles, Impact Pile Driver, All species, (160 dB RMS) | Steel Piles, Impact Pile Driver Harbor Seal (100 dB RMS), Other Pinnipeds (90 dB RMS) |
| Steller sea lion | 250 | 72 | 0 |
| California sea lion | 4,500 | 1,296 | 0 |
| Harbor seal | 49,625 | 0 | 0 |
| Harbor porpoise | 875 | 0 | N/A |
| Transient killer whale | 180 | 0 | N/A |

All underwater sound levels are expressed as dB re 1 μPa; all airborne sound levels are expressed as dB re 20 μPa.
dB = decibel; RMS = root mean square

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Sea lions hauled out on submarines at Delta Pier would be beyond the areas encompassed by the airborne noise behavioral harassment threshold for the SPE (Figure 3.4–5) and, therefore, are unlikely to be affected by construction activities. Animals swimming with their heads above the water would potentially be affected by elevated airborne pile driving noise within a small ZOI (197 feet [60 meters]). Given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, airborne pinniped takes would be encompassed by underwater exposures, and no additional incidental takes were requested for airborne noise. Therefore, the total number of exposures of Steller sea lions over the entire pile driving period for the SPE project is estimated to be 322 (all underwater).

Steller sea lions are unlikely to be injured by underwater pile driving noise because they are unlikely to be within the injury threshold distance for underwater pile driving noise (16 feet [5 meters] from the driven pile). Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities for the presence of marine mammals (see Mitigation Action Plan, Appendix C for a detailed discussion of mitigation measures), and they would alert work crews when to begin or stop work due to the presence of sea lions in or near the shutdown zones, thereby precluding the potential for injury.

Steller sea lions would most likely avoid waters within the areas affected by above-threshold noise levels during impact pile driving around the SPE project site. Steller sea lions exposed to elevated noise levels could exhibit behavioral changes such as avoidance of the affected area, increased swimming speed, increased surfacing time, or decreased foraging activity. Pile driving would occur only during daylight hours, and therefore would not affect nocturnal movements of Steller sea lions in the water. Most likely, Steller sea lions affected by elevated underwater or airborne noise would move away from the sound source and be temporarily displaced from the affected areas. However, they likely would continue using submarines at Delta Pier as haul-out sites during pile driving, based on evidence cited in Section 3.4.1.2.3 regarding responses of pinnipeds to construction noise including pile driving. Given the absence of any rookeries and only one haul-out area near the project site (i.e., submarines docked at Delta Pier), and infrequent occurrence by a small number of individuals at this site, potential disturbance exposures would have a negligible effect on individual Steller sea lions and would not result in population-level impacts.

The prey base of Steller sea lions includes forage fish and salmonids, which potentially would be less available for predators within the fish injury exposure and behavioral harassment zones (Section 3.3) during the 6-month, in-water construction window. The potential impact on Steller sea lions would be a localized (within the fish behavioral harassment zone), temporary loss of foraging opportunities (during in-water construction) and potential exposure to behavioral harassment as they transit the project area.

*California Sea Lion*

No regular haul-outs of California sea lions were documented during prior aerial surveys of pinniped populations in Hood Canal (Jeffries et al. 2000) over a decade ago, but the Navy's more recent observations of animals hauled out on submarines and the PSB on NAVBASE Kitsap Bangor indicate that California sea lions are now present in Hood Canal during much of the year. During the in-water construction period (July 15 to January 15), the maximum monthly attendance averaged for each month ranged from 1 to 74 individuals. The largest monthly average (74 animals) during the in-water work window was recorded in November, as was the largest daily count (122) (Table 3.4–20). The likelihood of California sea lions being present at the Bangor waterfront was greatest from October through May, when the frequency of occurrence in surveys was at least 0.80 (i.e., 80 percent of surveys had California sea lions present).

The noise exposure analysis for California sea lions is similar to the approach described above for Steller sea lions. The Navy used the average daily abundance of the species during the in-water work window, defined as the average of the monthly maximum number of individual present during surveys at Delta Pier from July 15 to January 15. From April 2008 through December 2015 the average of the monthly maximum number present during the in-water work window was approximately 36 animals (Table 3.4–20). Using the abundance-based analysis and the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), an average of 36 individual California sea lions may experience underwater sound pressure levels on a given day that would qualify as behavioral harassment. Over the 125 days of steel pile driving, the noise exposure formula predicts 4,500exposures to underwater noise within the behavioral harassment threshold for vibratory pile installation. Over the 36 days of concrete pile driving, the abundance-based formula predicts an additional 1,296 exposures due to impact pile driving, but the potential exposures are an overestimate because the ZOI is very small (approximately 151 feet [46 meters] from the driven pile). The total number of exposures over the entire pile driving period for this alternative is estimated to be 5,796 (all underwater) (Table 3.4–19).

**Table 3.4–20. California Sea Lions Observed at NAVBASE Kitsap Bangor, April 2008–December 2015**

| | | Maximum Number of California Sea Lions Observed in Single Survey | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | MAX Average |
| In-water Work Window July 15 - January 15 | July | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 1 |
| | August | 0 | 1 | 3 | 4 | 5 | 0 | 15 | 4 |
| | September | 12 | 32 | 33 | 14 | 11 | 35 | 44 | 26 |
| | October | 47 | 44 | 42 | 56 | 70 | 88 | 84 | 62 |
| | November | 50 | 58 | 42 | 81 | 70 | 122 | 93 | 74 |
| | December | 27 | 38 | 50 | 64 | 69 | N/A | 63 | 52 |
| | January | 4 | 44 | 33 | 43 | N/A | 48 | 43 | 36 |
| | February | 28 | 34 | 42 | 48 | 44 | 42 | 32 | 39 |
| | March | 37 | 40 | 54 | 82 | N/A | 65 | 55 | 56 |
| | April | 46 | 51 | 66 | 52 | 32 | 49 | 48 | 49 |
| | May | 33 | 17 | 54 | 18 | N/A | 20 | 12 | 26 |
| | June | 3 | 12 | 17 | 4 | N/A | 8 | 8 | 9 |
| | | | | | | | | **Average of in-water work window** | **36** |

Source: Navy 2015a
N/A = no survey was conducted

Sea lions are unlikely to be injured by pile driving noise because they are unlikely to be within the injury threshold distance for pile driving noise (16 feet [5 meters] from the driven pile). Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities for the presence of marine mammals (see Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures), and they would alert work crews when to begin or stop work due to the presence of sea lions in or near the shutdown zones, thereby precluding the potential for injury.

California sea lions would most likely avoid the waters within the areas affected by above-threshold noise levels during impact pile driving around the SPE project site. Sea lions exposed to elevated noise levels could exhibit behavioral changes such as avoidance of the affected area, increased swimming speed, increased surfacing time, or decreased foraging activity. Pile driving would occur only during daylight hours, and therefore would not affect nocturnal movements of sea lions in the water. Most likely, sea lions affected by elevated underwater or airborne noise would move away from the sound source and be temporarily displaced from the affected areas. However, they may continue using vessels at Delta Pier as haul-out sites during pile driving, based on evidence cited in Section 3.4.1.2.3 regarding responses of pinnipeds to construction noise including pile driving. Given the absence of any rookeries and only one haul-out area near the project site (i.e., submarines at Delta Pier and nearby PSB pontoons), potential disturbance exposures would have a negligible effect on individual California sea lions and would not result in population-level impacts.

The prey base of California sea lions includes forage fish and salmonids, which potentially would be less available for predators within the fish injury exposure and behavioral harassment zones (described in Section 3.3) during the 6-month, in-water construction window. The potential impact on California sea lions would be a localized (within the fish behavioral harassment zone), temporary loss (during in-water construction) of foraging opportunities, and potential exposure to behavioral harassment as they transit the project area.

*Harbor Seal*

Harbor seals are the most abundant marine mammal in Hood Canal. Jeffries et al. (2003) completed a comprehensive stock assessment of the Hood Canal in 1999 (September 21 between the hours of 3:00 and 4:00 p.m.) and counted 711 harbor seals hauled out. An estimate of the Hood Canal harbor seal population size was based on this survey data and haul-out behavior described by London et al (2012), who calculated an approximate correction factor for the survey count. Using haul-out probability from Figure 4 in London et al. (2012) the correction factor is calculated as follows:

> Approximate probability of an animal to be hauled out during that time frame in that month is 0.20. The inverse of this (1/0.20) provides a correction factor of 5.0. When applied to the survey count data of 711, the correction factor yields a population estimate of 3,555 animals.

Exposures to underwater and airborne pile driving noise were calculated using a density derived from the number of harbor seals that may be present in the water at any one time (80 percent of 3,555 or 2,844 individuals), divided by the area of Hood Canal (138.4 square miles [358.4 square kilometers]) (Jeffries et al. 2003; London et al. 2012). The density of harbor seals calculated in this manner is 20.55 animals/square mile [7.93/square kilometer]). The Navy acknowledges that a uniform density spread out over the Hood Canal is not ideal, and that the density would be higher around haul-out sites such as Dabob Bay and farther south in Hood Canal, which are 10 miles away from Bangor and those Bangor activities. Since the haul-out sites are not located near the Bangor waterfront, density is expected to be much lower near the project area. However, since a detailed geographically stratified density estimate is not currently available, the analysis uses the uniform density to calculate exposures to pile driving noise. Therefore, the exposure estimate for harbor seals presented here is likely a significant overestimate.

The airborne exposure calculations assumed that 100 percent of the in-water injury exposures would be from animals available at the surface to be exposed to airborne sound. Exposures to underwater noise were calculated with the formula in Section 3.4.2.2.2, under Underwater Noise, and the ZOI in Tables 3.4-15 and 3.4–16. Table 3.4–19 depicts the number of behavioral harassment exposures that are estimated from vibratory and impact pile driving both underwater and in-air.

Based on the density analysis of 20.55 individuals/square mile (7.93/square kilometer) and using the most conservative criterion for behavioral disturbance (the 120 dB vibratory harassment threshold with an area of 19.3 square miles [50.1 square kilometers]), up to 397 individual harbor seals may experience sound pressure levels on a given day that would qualify as behavioral harassment. The estimated number of individuals exposed per day accounts for approximately

10 percent of the estimated population, and as noted above is likely a significant overestimate of potential exposures. Thus, not all animals in the population would be expected to be exposed to the activities at Bangor but only a subset of the population that may travel through or haul-out on manmade structures near the waterfront. Furthermore, the behavioral harassment does not appear to be biologically significant based on observations from waterfront surveys conducted by the Navy (Navy 2015a): (1) harbor seals are always present in Bangor waters and occasionally use manmade structures (underside of piers, ladders in the water, wavescreen, floating oil boom, etc.) as haulouts; and (2) pupping occurs from the northern end to the southern end of the waterfront.

Over the 125 days of pile driving of 36-inch (90-centimeter) steel pile, the noise exposure formula above predicts 49,625 exposures to noise within the behavioral harassment threshold for vibratory pile installation. Zero exposures to underwater noise were calculated within the injury threshold (with an area of 850 square feet [79 square meters]). Over the 36 days of concrete pile driving, the noise exposure formula predicts zero exposures due to impact pile driving within the behavioral harassment threshold (with an area of 0.003 square miles [0.007 square kilometers]). Therefore, the total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 49,625 (all underwater) (Table 3.4–19).

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Animals swimming with their heads above the water would potentially be affected by elevated airborne pile driving noise within a small ZOI (620 feet [189 meters]). Given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, pinniped takes would already be encompassed by underwater exposures and no additional takes were requested for airborne noise exposures.

Harbor seals would most likely avoid waters within the areas affected by above-threshold noise levels during impact pile driving around the SPE project site. They are unlikely to be injured by pile driving noise because they are unlikely to be within the injury threshold distance for pile driving noise (16 feet [5 meters] from the driven pile). Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities for the presence of marine mammals (see Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures), and would alert work crews when to begin or stop work due to the presence of harbor seals in or near the shutdown zone, thereby precluding the potential for injury.

The prey base of harbor seals includes forage fish and salmonids, which would be less available for predators within the fish injury exposure and behavioral harassment zones (described in Section 3.3) during the 6-month, in-water construction window. The potential impact on harbor seals would be a localized (within the fish behavioral harassment zone), temporary loss of foraging opportunities (during in-water construction) and potential exposure to behavioral harassment as they transit the project area.

*Harbor Porpoise*

Harbor porpoise may be occasionally present in Hood Canal year round and conservatively are assumed to use the entire area. The Navy conducted boat surveys of the waterfront area from

July to September 2008 (Tannenbaum et al. 2009a) and November 2009 to May 2010 (Tannenbaum et al. 2011a). During one of the surveys a single harbor porpoise was sighted in May 2010 in the deeper waters in the vicinity of EHW-1. Overall, these nearshore surveys indicated a low occurrence of harbor porpoise within waters adjacent to the base. Surveys conducted during the TPP indicate that the abundance of harbor porpoises within Hood Canal in the vicinity of NAVBASE Kitsap Bangor is greater than anticipated from earlier surveys and anecdotal evidence (HDR 2012). During these surveys, while harbor porpoise presence in the immediate vicinity of the base (i.e., within 0.6 mile [1 kilometer]) remained low, harbor porpoise were frequently sighted within several kilometers of the base, mostly to the north or south of the project area, but occasionally directly across from the proposed EHW-2 project site on the far side of Toandos Peninsula. These surveys reported 38 individual harbor porpoise sightings on tracklines of specified length and width, resulting in a density of 0.149 individuals/square kilometer.

The density used in the underwater sound exposure analysis was 0.149 animals/square kilometer (Navy 2013). Exposures to underwater pile driving noise were calculated using the formula in Section 3.4.2.3.2, under Underwater Noise, and the ZOI in Table 3.4–17. Table 3.4-19 depicts the number of potential behavioral harassment exposures that are estimated from underwater vibratory and impact pile driving.

Based on the density analysis of 0.38 individuals/square mile (0.149/square kilometer) (Navy 2013) and using the most conservative criterion for behavioral disturbance (the 120 dB vibratory harassment threshold with an area of 19.3 square miles [50.1 square kilometers]), up to 7 individual harbor porpoises may experience sound pressure levels on a given day that would qualify as behavioral harassment due to vibratory pile driving. Over the 125 days of pile driving of 36-inch (90-centimeter) steel pile, the noise exposure formula above predicts 875 exposures to noise within the behavioral harassment threshold for vibratory pile installation. Zero exposures to underwater noise were calculated within the injury threshold (with an area of 21,022 square feet [1,953 square meters]). Over the 36 days of 18-inch (45-centimeter) concrete pile driving, the density-based formula predicts zero exposures due to impact pile driving within the behavioral harassment threshold (with an area of 0.003 square miles [0.007 square kilometers]). Therefore, the total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 875 (Table 3.4–19).

Harbor porpoise that are exposed to pile driving noise could exhibit behavioral reactions such as avoidance of the affected area. Harassment from underwater noise impacts is not expected to be significant because it is estimated that only a small number of harbor porpoise would ever be present in the project area. Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see Mitigation Action Plan, Appendix C for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of harbor porpoise in or near the shutdown zones, thereby reducing the potential for injury.

*Transient Killer Whale*

Transient killer whales are rarely present in Hood Canal. In 2003 and 2005, groups of transient killer whales (6 to 11 individuals per event) visited Hood Canal to feed on harbor seals and remained in the area for significant periods of time (59 to 172 days) between the months of January and July (London 2006). These whales used the entire expanse of Hood Canal for feeding. No other confirmed sightings of transient killer whales in Hood Canal were reported.

Even though transient killer whales are rare in Hood Canal and an applicable density value is not available, the Navy calculated potential exposures for SPE in the event that a small group may occur within the SPE behavioral disturbance ZOI. For transient killer whales, there have only been two documented time periods of occurrence within Hood Canal and, therefore, a reliable density estimate is not available.

Take estimates were calculated based on the in-water work associated with the construction of SPE. Exposures to underwater pile driving were calculated using the second equation described in the *Description of Exposure Calculation* (page 3.4-68) where the exposure estimate was determined by multiplying the group size times the number of days transient killer whales would be anticipated in the Hood Canal during pile driving activities.

West Coast transient killer whale mean group size in the Salish Sea was 4 individuals during the period from 1987–1993 (mode = 3 individuals) (Baird and Dill 1996). More recently, during the period from 2004–2010, mean group size appears to have increased to 5 individuals (mode = 4 individuals) (Houghton et al. 2015). According to Houghton unpublished data, the most commonly observed group size in Puget Sound (specifically south of Admiralty Inlet) from 2004–2010 data was 6 whales (mode = 6, mean = 6.88) (Houghton 2012, personal communication).

Based on the two documented residence times transient killer whales remained in Hood Canal (59 to 172 days between the months of January and July), NMFS concluded that whales could be exposed to behavioral disturbance due to pile driving noise for 30 days (NMFS 2014). The 30 day estimate reasonably assumes that the whales would not remain in the area for the typical residence time due to the harassing stimuli.

Using this rationale, 180 potential exposures of transient killer whales are estimated (6 animals times 30 days of exposure). Based on this analysis, the Navy requests Level B incidental takes for behavioral harassment of 180 killer whales. Animals of any age or sex could be exposed. Any exposures are anticipated to be short in duration as animals transit through the ZOI during vibratory pile driving.

Transient killer whales that are exposed to pile driving noise could exhibit behavioral reactions such as avoidance of the affected area. Harassment from underwater noise impacts is not expected to be significant because it is estimated that only a small number of transient killer whales would ever be present in the project area. Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of transient killer whales in or near the shutdown zones, thereby reducing the potential for injury.

OPERATION/LONG-TERM IMPACTS FOR SPE ALTERNATIVE 2

*PREY AVAILABILITY*

SPE Alternative 2 would increase the length of the existing pier by 540 feet, permanently displacing a small area (0.045 acre [0.018 hectare]) of deeper water benthic habitat. Given the water depth, the overwater structures would have a minor effect on biological productivity in the larger area affected by shading (approximately 1 acre [0.41 hectare]) (Section 3.2.2.3.2). Moreover, these impacts would occur in deeper water habitat and be highly localized to the immediate vicinity of the pier. Therefore, habitat degradation and barriers for fish in the project area would not result in a significant change in the prey base for marine mammals, as discussed in Section 3.3.2.3.2. Increased artificial lighting at the SPE may affect prey availability, depending on the species, for marine mammals. Some fish such as sand lance, an important forage fish, may be attracted by artificial lighting, which may in turn attract predators, including marine mammals, and facilitate predation on these prey species. Thus, localized changes to the prey base for some marine mammals are possible but these changes cannot be quantified with available information.

*NOISE AND VISUAL DISTURBANCE*

Cetaceans are unlikely to be present in the waters affected by the Service Pier but pinnipeds may swim through the area. These species are highly mobile and accustomed to utilizing the waters around manmade structures on the Bangor waterfront; therefore, they would not be significantly affected by the presence of this in-water barrier and the associated levels of human activity. Increased vessel traffic would occur with this alternative, but the vessels would be slow moving and unlikely to result in collisions with pinnipeds. Underwater noise levels would increase with increased vessel traffic but would not rise to the injury level. Pinnipeds that utilize the Bangor waterfront have habituated to vessel traffic noise and may avoid the immediate vicinity of disturbing sound levels.

The potential for transits of Navy vessels, including submarines, to affect marine mammals was addressed in the Northwest Training and Testing EIS (Navy 2015b), which is incorporated here by reference. That EIS found that Navy vessels would pass near marine mammals only on an incidental basis. Marine mammals exposed to a passing Navy vessel may not respond at all, or they may exhibit a short-term behavioral response such as avoidance or changing dive behavior. Due to the infrequency of Navy vessel traffic, marine mammals would not be anticipated to experience chronic disturbance from Navy activities. Short-term reactions to vessels would not be likely to disrupt major behavioral patterns or to result in serious injury to any marine mammals. Acoustic masking may occur due to vessel sounds, but the potential is low for submarines, which generate less sound during transit than other vessels. Acoustic masking may prevent an animal from perceiving biologically relevant sounds during the period of exposure, potentially resulting in missed opportunities to obtain resources. Regarding collisions with marine mammals, SSN submarines, which would be on the surface during transits, would have lookouts posted to detect and avoid marine mammals at the surface.

Operation of SPE Alternative 2 would include increased noise and visual disturbance from human activity and artificial light. Under existing conditions, the Bangor waterfront produces an environment of complex and highly variable noise and visual disturbance for marine mammals. Steller and California sea lions haul out on manmade structures and harbor seals regularly forage in the nearshore and deeper waters along the Bangor waterfront in close proximity to ongoing operations. Although future levels of human activity at the larger Service Pier would be greater than existing levels, due to docking two additional submarines at the pier, most individual marine mammals are likely to habituate to the post-construction activity levels, as they have habituated to activity levels at other developed portions of the waterfront. Thus, no additional MMPA take is expected with operation of the Service Pier under Alternative 2.

Maintenance of the SPE would include routine inspections, repair, and replacement of facility components as required (but no pile replacement). These activities could affect marine mammals through noise impacts and increased human activity and vessel traffic. However, noise levels would not be appreciably higher than existing levels elsewhere at the Bangor industrial waterfront, to which marine mammals appear to have habituated. Measures would be employed (Section 3.1.1.2.3) to avoid discharge of contaminants to the marine environment. Therefore, maintenance would have negligible impacts on marine mammals.

California sea lions, Steller sea lions, and harbor seals haul out on docked submarines at Delta Pier and the pontoons that support the existing PSB. They may haul out on submarines docked at the Service Pier in the future because they habituate to human activity in the vicinity of attractive haul-out sites. The shoreline in the project area is not used for hauling out by any pinniped species under existing conditions, and it is unlikely that pinnipeds would haul out on the shoreline in the vicinity of the Service Pier in the future.

#### 3.4.2.3.3. SPE ALTERNATIVE 3: LONG PIER

SPE Alternative 3 would increase the length of the existing pier by 975 feet (297 meters), or almost twice the length of the SPE under Alternative 2. The number of piles and pile driving days would be greater for Alternative 3 than for Alternative 2, thereby increasing the duration of elevated underwater and airborne noise levels due to pile driving. Long-term operations of the SPE would be similar to Alternative 2 with insignificant consequences for marine mammal populations.

##### CONSTRUCTION OF SPE ALTERNATIVE 3

Marine mammals are expected to avoid disturbed areas due to increased vessel traffic, noise and human activity, increased turbidity, and potential difficulty in finding prey. General concerns over construction period impacts, including water quality, vessel traffic, prey availability, and construction noise, are the same as for SPE Alternative 2, but overall SPE Alternative 3 would have greater and longer-lasting impacts on marine mammals in the project area.

*WATER QUALITY*

A larger seafloor area (6.6 acres [2.7 hectares]) would be disturbed by construction of SPE Alternative 3, which would cause increasing turbidity levels and suspended sediments compared to Alternative 2 (3.9 acres [1.6 hectares]) (Table 3.2–5) (Section 3.1.2.3.3). Similar to Alternative 2, water quality impacts under Alternative 3 would be temporary and localized within the construction corridor (Section 3.1.2.3.3). Construction-period impacts are not expected to exceed water quality standards. Therefore, no direct impacts on marine mammals are expected due to water quality effects of SPE construction under Alternative 3.

*VESSEL TRAFFIC*

The same levels of vessel traffic including barge and tug trips (average 6 round trips per month) would be required over more pile driving days for construction of Alternative 3 (205 days) compared to Alternative 2 (161 days). Thus, SPE Alternative 3 would increase overall disturbance levels for marine mammals in the project vicinity and potentially displace them for longer periods of time. However, the affected area would be limited to the project vicinity and, relative to the wide distribution of marine mammal species in inland water, would not affect population sizes or overall distribution.

*PREY AVAILABILITY*

Impacts of construction on prey availability for fish-eating marine mammals would be similar under both SPE alternatives. Similar to Alternative 2, the greatest impacts on prey species during construction of the SPE project would result from resuspension of sediments, localized turbidity, and behavioral disturbance due to pile driving noise. However, because the area affected under Alternative 3 (6.6 acres [2.7 hectares]) is greater than under Alternative 2 (3.9 acres [1.6 hectares]), the magnitude of the impact under Alternative 3 would be greater. The affected area under either alternative would be limited to the construction footprint. Relative to the wide distribution of marine mammals and their prey resources in inland waters, Alternative 3 would not affect population size or overall distribution of these species.

Construction of Alternative 3 would expose fish populations to potential injury and behavioral disturbance due to underwater pile driving noise (Section 3.3.2.3.3). The time period for behavioral disturbance of fish populations would be greater for Alternative 3 compared to Alternative 2 because a more pile-driving days would be required (205 pile driving days with Alternative 3 compared to 161 pile driving days with Alternative 2). Fish potentially would be disturbed by pile driving noise resulting from operation of vibratory and impact rigs within 7,068 feet (2,154 meters) of impact pile driving and 178 feet (54 meters) of vibratory pile driving, but may actually avoid a much smaller area (Section 3.3.2.3.3).

In the long term, a larger pier footprint would shade a larger area of benthic habitats under Alternative 3 compared to Alternative 2. However, relative to the wide distribution of marine mammal species and their prey resources in inland marine waters, effects of Alternative 3 on prey availability would not amount to a significant impact on marine mammal populations. Both alternatives may indirectly affect Southern Resident killer whales through effects on their prey populations, but the project's effect on the species' prey base would be minimal. Therefore, the ESA effect determination for construction activities under Alternative 3 is "may affect, not likely to adversely affect" Southern Resident killer whales. The project would have no effect on critical habitat for Southern Resident killer whales because no critical habitat has been designated in Hood Canal.

*UNDERWATER NOISE*

Underwater and airborne pile driving and heavy equipment noise levels at any given time during construction would be similar for both SPE alternatives and either alternative would involve in-water pile driving during two in-water construction seasons. The analysis of underwater pile driving noise effects is similar to that described in Section 3.4.2.3.2, with the exception of the source levels used in the exposure calculations. Vibratory pile driving of 24-inch (60-centimeter) steel piles would produce noise levels of approximately 161 dB RMS re 1 µPa at 33 feet (10 meters) from the pile. Impact pile driving of 24-inch steel piles using a single-acting diesel impact hammer would produce average RMS noise levels of 185 dB RMS re 1 µPa at 33 feet, while using a bubble curtain reduces noise levels by 8 dB. Other mitigation measures, including a soft-start approach for pile driving operations and marine mammal monitoring and shutdown zones during pile driving, are described in the Mitigation Action Plan (Appendix C). The project would also require pile driving of 18-inch (45-centimeter) square concrete piles. The source level for this pile driving is 170 dB RMS re 1 µPa at 33 feet (Appendix D). All of the concrete piles would be installed with an impact hammer. A bubble curtain would not be used for installation of concrete piles because the source level at 33 feet is lower than the injury impact thresholds for marine mammals (180 dB RMS for cetaceans and 190 dB RMS for pinnipeds) (Table 3.4–14). Most of the energy in pile driving sound underwater is contained in the frequency range 25 Hz and 1.6 kHz, with the highest energy densities between 50 and 350 Hz (Reyff et al. 2002). In some studies, underwater pile driving noise has been reported to range up to 10 kHz with peak amplitude below 600 Hz (Laughlin 2005).

The areas encompassed by these threshold distances within the SPE Alternative 3 project area are shown in Table 3.4–21, and a representative scenario of areas affected by above-threshold noise levels is shown in Figure 3.4-6. The representative areas in Figure 3.4–6 depict effects related to operation of a pile driver at one location at the seaward end of the SPE, but pile driving would occur along the entire length of the pier during the course of project construction. Only one impact pile driver would operate at a time. Table 3.4–21 shows the ZOIs affected by pile driving at this representative location. Placement of pile driving rigs at other locations along the SPE alignment would generate above-threshold noise levels in slightly different areas.

With a properly functioning bubble curtain in place on the impact hammer rig, construction of SPE Alternative 3 would likely result in noise-related injury to pinnipeds and cetaceans within 16 feet (5 meters) and 72 feet (22 meters) from a driven pile, respectively (Table 3.4–21). Injury exposure to intense underwater noise could consist of PTS or other tissue damage. However, marine mammals are unlikely to be injured by pile driving noise at these short distances because the high level of human activity and vessel traffic would cause them to avoid the immediate construction area. Cetaceans in particular are unlikely to swim this close to manmade structures. In addition, marine mammal monitoring during construction (Mitigation Action Plan, Appendix C, Section 4.2) would preclude exposure to injury from pile driving noise.

**Table 3.4–21. Calculated Maximum Distance(s) to the Underwater Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Current Noise Thresholds, SPE Alternative 3**

| Affected Area | Impact Injury Pinnipeds (190 dB RMS)[1] | Impact Injury Cetaceans (180 dB RMS)[1] | Impact Behavioral Harassment Cetaceans & Pinnipeds (160 dB RMS)[1] | Vibratory Behavioral Harassment Cetaceans & Pinnipeds (120 dB RMS)[2] |
|---|---|---|---|---|
| **24-inch (60-centimeter) Steel Piles** | | | | |
| Distance to Threshold[1] | 16 ft (5 m) | 72 ft (22 m) | 1,522 ft (464 m) | 3.4 mi (5.4 km) |
| Area Encompassed by Threshold | 850 sq ft (79 sq m) | 16,372 sq ft (1,521 sq m) | 0.21 sq mi (0.53 sq km) | 9.6 sq mi (24.8 sq km) |
| **18-inch (45-centimeter) Concrete Piles** | | | | |
| Distance to Threshold[3] | <2 ft (<1 m) | 7 ft (2 m) | 151 ft (46 m) | N/A |
| Area Encompassed by Threshold | Negligible | Negligible | 0.003 sq mi (0.007 sq km) | N/A |

dB = decibel; ft = feet; m = meter; RMS = root mean square; sq ft = square feet; sq km = square kilometer; sq m = square meter; sq mi = square mile

1. Bubble curtain assumed to achieve 8 dB reduction in sound pressure levels during impact pile driving. Sound pressure levels used for calculations were: 185 dB re 1 μPa at 33 feet (10 meters) for impact hammer with bubble curtain and 161 dB re 1 μPa for vibratory driver for 24-inch (60-centimeter), hollow steel pile. All sound levels are expressed in dB RMS re 1 μPa.
2. Calculated area is greater than actual sound propagation through Hood Canal due to intervening land masses. Thus, 3.4 miles (5.4 kilometers) is the greatest line-of-sight distance from pile driving locations unimpeded by land masses.
3. Sound pressure levels used for calculations were 170 dB re 1 μPa at 33 feet (10 meters) for impact hammer without bubble curtain.

Behavioral disturbance due to impact pile driving is calculated at approximately 1,522 feet (464 meters) from the driven pile, resulting in an affected area of approximately 0.21 square mile (0.53 square kilometer) around the driven pile. Marine mammals within this area would be susceptible to behavioral harassment during impact pile driving operations. The calculated distance for the behavioral harassment threshold due to vibratory installation is approximately 3.4 miles (5.4 kilometers), but intervening land masses would truncate the propagation of underwater pile driving sound from a driven pile (Figure 3.4–6). The area encompassed by the truncated threshold distance is approximately 9.6 square miles (24.8 square kilometers) around the pile drivers (Figure 3.4–6). Marine mammals within this area would be susceptible to behavioral harassment due to vibratory pile driving operations.

The number of pile driving days would be greater for Alternative 3 (155 days of pile driving for steel pile and 50 days for concrete pile compared to 125 days for steel pile, and 36 days for concrete pile for Alternative 2). A comparison of the number of exposures for marine mammals for Alternatives 2 and 3 are shown in Table 3.4–22. For simplicity, this comparison includes only the exposure thresholds for which exposures greater than zero were calculated or adjusted. Representative views of areas within the ZOIs for behavioral harassment due to underwater pile driving noise for Alternative 3 are shown in Figure 3.4–6.

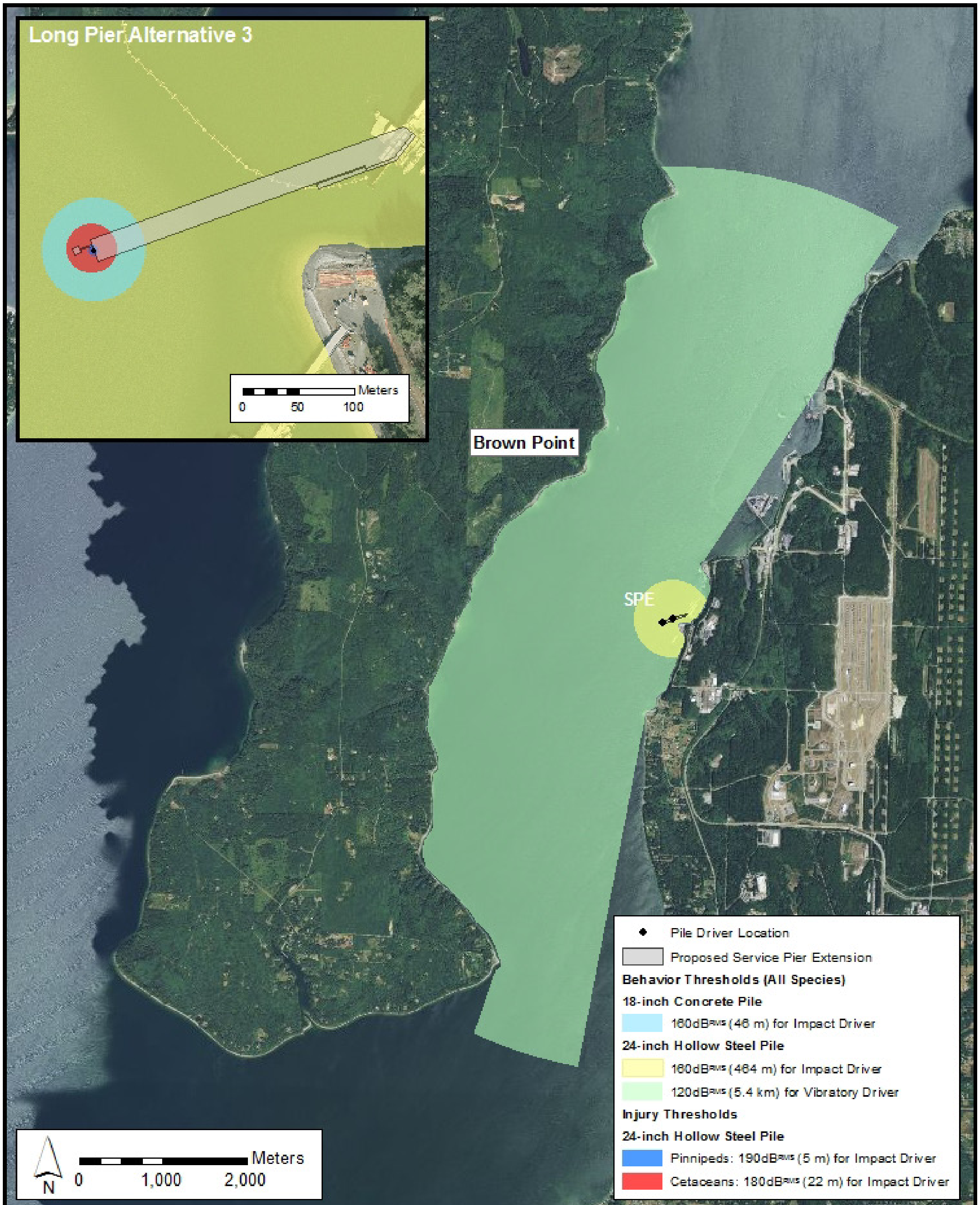


**Figure 3.4-6. Representative View of Affected Areas for Marine Mammals due to Underwater Pile Driving Noise during Construction of SPE Alternative 3**

**Table 3.4–22. Comparison of Potential Exposures for All Marine Mammal Species during the In-Water, Pile-Driving Season (Mid-July to Mid-January), SPE Alternatives 2 and 3**

| Species | Alternative 2 – Underwater Behavioral Harassment | | | Alternative 3 – Underwater Behavioral Harassment | | |
|---|---|---|---|---|---|---|
| | Steel piles, Vibratory Pile Driver (120 dB RMS) | Concrete Piles, Impact Pile Driver, (160 dB) | Total | Steel piles, Vibratory Pile Driver (120 dB RMS) | Concrete Piles, Impact Pile Driver, (160 dB) | Total |
| Steller sea lion | 250 | 72 | 322 | 310 | 100 | 410 |
| California sea lion | 4,500 | 1,296 | 5,796 | 5,580 | 1,800 | 7,380 |
| Harbor seal | 49,625 | 0 | 49,625 | 30,535 | 0 | 30,535 |
| Harbor porpoise | 875 | 0 | 875 | 620 | 0 | 620 |
| Transient killer whale | 180 | 0 | 180 | 180[1] | 0 | 180 |

dB = decibel; RMS = root mean square

*AIRBORNE NOISE*

Construction of SPE Alternative 3 would result in increased airborne noise in the vicinity of the construction site, as discussed in Section 3.9.3.3. The highest noise source levels would be associated with impact pile driving (500 24-inch [60-centimeter] steel support piles and 160 18-inch [45-centimeter] concrete fender piles). The worst-case pile driving source level (for 24-inch steel piles) is estimated to be 110 dB RMS re 20 μPa (unweighted) at 50 feet (15 meters) from the pile for an impact hammer, and 92 dB RMS re 20 μPa (unweighted) at 50 feet from the pile for vibratory pile driving (Section 3.9.3.2.2). The dominant airborne noise frequencies produced by pile driving are between 50 and 1,000 Hz (WSDOT 2013). No airborne source levels were available for 18-inch (45-centimeter) concrete piles. Modeled distances to airborne thresholds would likely be considerably smaller for concrete piles than for steel piles.

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Sea lions hauled out on submarines at Delta Pier would be beyond the areas encompassed by the airborne noise behavioral harassment threshold for SPE Alternative 3 (Figure 3.4–5) and, therefore, are unlikely to be affected by construction activities. Airborne impact pile driving noise for the SPE would likely result in behavioral harassment to harbor seals at a distance of 492 feet (150 meters) and to other pinnipeds (California sea lions and Steller sea lions) at a distance of 154 feet (47 meters) (Table 3.4–23). Vibratory pile driving noise would likely result in behavioral harassment to harbor seals at a distance of 62 feet (19 meters) and to other pinnipeds at a distance of 20 feet (6 meters) (Table 3.4–23). The areas encompassed by these threshold distances are shown in Table 3.4–23 and a representative scenario of areas affected by above-threshold airborne noise levels for an impact pile driving rig is shown in Figure 3.4–5. Other areas would be included in the above-threshold noise areas if the analysis was performed for pile driving rigs at other locations on the SPE structure. Similar to SPE Alternative 2, given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, any airborne pinniped takes would already be encompassed within underwater exposures.

**Table 3.4–23. Calculated Maximum Distances in Air to Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Noise Thresholds, SPE Alternative 3**

| Affected Area | Impact Behavioral Harassment Harbor Seal (90 dB RMS)[1] | Impact Behavioral Harassment Other Pinnipeds (100 dB RMS)[1] | Vibratory Behavioral Harassment Harbor Seal (90 dB RMS)[1] | Vibratory Behavioral Harassment Other Pinnipeds (100 dB RMS)[1] |
|---|---|---|---|---|
| Distance to Threshold[1] | 492 ft (150 m) | 154 ft (47 m) | 62 ft (19 m) | 20 ft (6 m) |
| Area Encompassed by Threshold | 0.03 sq mi (0.07 sq km) | 0.003 sq mi (0.007 sq km) | 12,076 sq ft (1,134 sq m) | 1,385 sq ft (129 sq m) |

dB = decibel; ft = feet; m = meter; RMS = root mean square; sq km = square kilometer; sq mi = square mile

1. Sound pressure levels used for calculations were 110 dB RMS re 20 μPa at 50 feet (15 meters) (Section 3.9.3.3.2) for impact hammer for 24-inch (690-centimeter) steel pile, and 92 dB RMS re 20 μPa at 50 feet (15 meters) for vibratory driver for 24-inch steel pile. All distances are calculated over water.

*SUMMARY OF PROJECT IMPACTS AND ESTIMATED EXPOSURES FOR SPECIES PRESENT IN THE SPE PROJECT AREA*

*Steller Sea Lion*

Using the abundance-based analysis and the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), an average daily abundance of 2 individual Steller sea lions may experience underwater sound pressure levels that would qualify as behavioral harassment on a given day. The noise exposure formula above predicts 310 exposures to underwater noise within the behavioral harassment threshold for vibratory pile installation over the 155 days of pile driving for 24-inch (60-centimeter) steel pile. Zero exposures are expected to occur from underwater noise within the injury threshold (with an area of 850 square feet [79 square meters]). Over the 50 days of concrete pile driving, the abundance-based formula predicts an additional 100 exposures due to impact pile driving, but the potential exposures calculated this way would be an overestimate because the affected area would be very small (approximately 151 feet [46 meters] from the driven pile) and Steller sea lions would be unlikely to approach active pile driving sites at this distance.

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Animals swimming with their heads above the water would potentially be affected by elevated airborne pile driving noise within a small ZOI (154 feet [47 meters]). Given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, pinniped takes would already be encompassed by underwater exposures, and no additional takes were requested for airborne noise exposures. The total number of exposures over the entire pile driving period for this alternative is estimated to be 410 (all underwater) (Table 3.4–22).

*California Sea Lion*

Using the abundance-based analysis and the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), an average of 36 individual California sea lions may experience underwater sound pressure levels on a given day that would qualify as behavioral harassment. Over the 155 days of steel pile driving, the noise exposure formula predicts 5,580 exposures to underwater noise within the behavioral harassment threshold for vibratory pile installation. Zero exposures are expected to occur from underwater noise within the injury threshold (with an area of 850 square feet [79 square meters]). Over the 50 days of concrete pile driving, the abundance-based formula predicts an additional 1,800 exposures due to impact pile driving, but the potential exposures are an overestimate because the ZOI is very small (approximately 151 feet [46 meters] from the driven pile).

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Animals swimming with their heads above the water would potentially be affected by elevated airborne pile driving noise within a small ZOI (154 feet [47 meters]). Given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, pinniped takes would already be encompassed by underwater exposures and no additional takes were requested for airborne noise exposures. The total number of exposures over the entire pile driving period for this alternative is estimated to be 7,380 (all underwater) (Table 3.4-22).

*Harbor Seal*

Based on the density analysis of 20.55 individuals/square mile (7.93/square kilometer) and using the most conservative criterion for behavioral disturbance (the 120 dB vibratory harassment threshold with an area of 9.6 square miles [24.8 square kilometers]), up to 197 individual harbor seals may experience sound pressure levels on a given day that would qualify as behavioral harassment. The estimated number of individuals exposed per day accounts for approximately 5.5 percent of the estimated population, and as noted above is likely a significant overestimate of potential exposures. Thus, not all animals in the population would be expected to be exposed to the activities at Bangor but only a subset of the population that may travel through or haul-out on manmade structures near the waterfront. Furthermore, the behavioral harassment does not appear to be biologically significant based on observations from waterfront surveys conducted by the Navy (Navy 2015a): (1) harbor seals are always present in Bangor waters and occasionally use manmade structures (underside of piers, ladders in the water, wavescreen, floating oil boom, etc.) as haulouts; and (2) pupping occurs from the northern end to the southern end of the waterfront.

Over the 155 days of pile driving of 24-inch (60-centimeter) steel pile, the noise exposure formula above predicts 30,535 exposures to noise within the behavioral harassment threshold for vibratory pile installation. Zero exposures to underwater noise were calculated within the injury threshold (with an area of 850 square feet [79 square meters]). Over the 50 days of concrete pile driving, the noise exposure formula predicts zero exposures due to impact pile driving within the behavioral harassment threshold (with an area of 0.003 square miles [0.007 square kilometers]).

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Animals swimming with their heads above the water would potentially be affected by elevated airborne pile driving noise within a small ZOI (492 feet [150 meters]). Given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, pinniped takes would already be encompassed by underwater exposures and no additional takes were requested for airborne noise exposures. Therefore, the total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 30,535 (all underwater) (Table 3.4–22).

*Harbor Porpoise*

Based on the density analysis of 0.38 individuals/square mile (0.149/square kilometer) (Navy 2013) and using the most conservative criterion for behavioral disturbance (the 120 dB vibratory harassment threshold with an area of 9.6 square miles [24.8 square kilometers]), up to 4 individual harbor porpoises may experience sound pressure levels on a given day that would qualify as behavioral harassment. Over the 155 days of pile driving of 24-inch (60-centimeter) steel pile, the noise exposure formula above predicts 620 exposures to noise within the behavioral harassment threshold for vibratory pile installation. Zero exposures to underwater noise were calculated within the injury threshold (with an area of 16,372 square feet [1,521 square meters]). Over the 50 days of 18-inch (45-centimeter) concrete pile driving, the density-based formula predicts zero exposures due to impact pile driving within the behavioral harassment threshold (with an area of 0.003 square miles [0.007 square kilometers]). Therefore, the total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 620 (Table 3.4–22).

*Transient Killer Whale*

Exposures to underwater pile driving were calculated using the second equation described in the *Description of Exposure Calculation* (page 3.4-68) where the exposure estimate was determined by multiplying the group size times the number of days transient killer whales would be anticipated in the Hood Canal during pile driving activities.

West Coast transient killer whale mean group size in the Salish Sea was 4 individuals during the period from 1987–1993 (mode = 3 individuals) (Baird and Dill 1996). More recently, during the period from 2004–2010, mean group size appears to have increased to 5 individuals (mode = 4 individuals) (Houghton et al. 2015). According to Houghton unpublished data, the most commonly observed group size in Puget Sound (specifically south of Admiralty Inlet) from 2004–2010 data was 6 whales (mode = 6, mean = 6.88) (Houghton 2012, personal communication).

Based on the two documented residence times transient killer whales remained in Hood Canal (59 to 172 days between the months of January and July), NMFS concluded that whales could be exposed to behavioral disturbance due to pile driving noise for 30 days (NMFS 2014). The 30 day estimate reasonably assumes that the whales would not remain in the area for the typical residence time due to the harassing stimuli.

Using this rationale, 180 potential exposures of transient killer whales are estimated (6 animals times 30 days of exposure). Based on this analysis, the Navy requests Level B incidental takes for behavioral harassment of 180 killer whales. Animals of any age or sex could be exposed. Any exposures are anticipated to be short in duration as animals transit through the ZOI during vibratory pile driving.

OPERATION/LONG-TERM IMPACTS FOR SPE ALTERNATIVE 3

The long-term operational impacts of SPE Alternative 3 would be qualitatively similar to those described for Alternative 2 but the magnitude of impacts would be greater for Alternative 3, with the exception of underwater noise exposures from pile driving. With the use of a smaller steel pile size (24-inch [60-centimeter]), the ZOI is smaller for SPE Alternative 3 and therefore results in less exposures.

SPE Alternative 3 would increase the length of the existing pier by 975 feet (297 meters), permanently displacing a larger area of deeper water benthic habitat than Alternative 2, and potentially affecting a small amount of habitat supporting prey species. Given the water depth at the SPE site, shading by the overwater structures would have a minor effect on biological productivity (see Section 3.2.2.3.2). Similar to Alternative 2, impacts on the prey base for some marine mammals are not expected to be significant, but these changes cannot be quantified with available information. Marine mammals are wide-ranging and have extensive foraging habitat available in Hood Canal, relative to the foraging area that might be impacted by operation of the SPE. Localized changes in prey availability are possible under Alternative 3 but are expected to be insignificant. The Mitigation Action Plan (Appendix C) describes the marine habitat mitigation that the Navy would undertake as part of the Proposed Action. This habitat mitigation would compensate for impacts of the Proposed Action to marine habitats and species that might indirectly affect the marine mammal prey base.

Impacts of increased vessel traffic and vessel noise from Alternative 3 would be similar to the impacts described for Alternative 2 because the number of submarines berthed at the enlarged Service Pier would be the same. Cetaceans are unlikely to frequent the area, and pinnipeds that utilize the Bangor waterfront have habituated to vessel traffic noise and may avoid the immediate vicinity of disturbing sound levels.

Operation of the larger Service Pier would include increased noise and visual disturbance from human activity and artificial light. Similar to impacts of Alternative 2, most pinnipeds are likely to habituate to the post-construction activity levels, as they have habituated to activity levels at other developed portions of the waterfront. Thus, no additional MMPA take is expected with operation of the larger Service Pier.

Maintenance of the SPE would include routine inspections, repair, and replacement of facility components as required (but no pile replacement). These activities could affect marine mammals through noise impacts and increased human activity and vessel traffic. However, noise levels would not be appreciably higher than existing levels elsewhere at the Bangor industrial waterfront, to which marine mammals appear to have habituated. Measures would be employed (Section 3.1.1.2.3) to avoid discharge of contaminants to the marine environment. Therefore, maintenance for the SPE would have negligible impacts on marine mammals.

#### 3.4.2.3.4. Summary of Impacts for SPE Project Alternatives

Impacts on marine mammals during the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.4–24.

**Table 3.4–24. Summary of SPE Impacts on Marine Mammals**

| Alternative | Environmental Impacts on Marine Mammals |
| --- | --- |
| SPE Alternative 1: No Action | No impact. |
| SPE Alternative 2: Short Pier (Preferred) | *Construction:* Direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability due to extension of pier by 540 feet (165 meters). Construction noise (primarily due to pile driving) sufficient to exceed NMFS disturbance thresholds. Construction disturbance due to in-water work would occur over two seasons, including a total of 161 days of pile driving.<br>*Operation/Long-term Impacts:* Minor indirect impacts on prey species due to loss and degradation of benthic habitat; increased human activity, vessel traffic, and noise. |
| | *MMPA:* The Proposed Action would expose marine mammal species in the area to noise levels that would result in behavioral disturbance. No injurious exposures to noise are expected due to the use of vibratory pile driving as the primary pile installation method, the small size of the injury zone from impact pile driving, and monitoring of the injury zone so that a shutdown would occur if a marine mammal approaches the zone.<br>*ESA:* Effect determination for the humpback whale (based on infrequent occurrence) and Southern Resident killer whale is “may affect, not likely to adversely affect”; and “no effect” on Southern Resident killer whale critical habitat.” |
| SPE Alternative 3: Long Pier | *Construction:* Direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability due to extension of pier by 975 feet (297 meters) compared to 540 feet (165 meters) with the short pier for Alternative 2. Construction noise (primarily due to pile driving) sufficient to exceed NMFS disturbance thresholds. Construction disturbance due to in-water work would occur over two seasons, including a total of 205 days of pile driving compared to 161 days for Alternative 2.<br>*Operation/Long-term Impacts:* Minor indirect impacts on prey species due to loss and degradation of benthic habitat; increased human activity, vessel traffic, and noise. |
| | *MMPA:* The Proposed Action would expose marine mammal species in the area to noise levels that would result in behavioral disturbance. No injurious exposures to noise are expected due to the use of vibratory pile driving as the primary pile installation method, the small size of the injury zone from impact pile driving, and monitoring of the injury zone so that a shutdown would occur if a marine mammal approaches the zone.<br>*ESA:* Effect determination for the humpback whale (based on infrequent occurrence) and Southern Resident killer whale is “may affect, not likely to adversely affect”; and “no effect” on Southern Resident killer whale critical habitat. |
| **Mitigation:** Marine mammals would be monitored during all pile installation activities of the SPE project, and shutdown procedures would be implemented if any marine mammal enters the injury threshold zone for pile driving. Please see Appendix C (Mitigation Action Plan) for more detailed mitigation measures. A detailed marine mammal monitoring plan would be developed in consultation with NMFS. | |
| **Consultation and Permit Status**<br>The Navy submitted an IHA application to NMFSHQ for the construction of the SPE project on November 24, 2014, and issued a supplement to the application in June 2015. The Navy will continue its consultation with NMFSHQ in order to obtain an IHA for the SPE preferred alternative. The Navy consulted with the NMFS West Coast Region Office on the Southern Resident killer and humpback whale under the ESA, submitted a Biological Assessment on March 10, 2015, and submitted a revised Biological Assessment on June 10, 2015. ESA consultation with NMFS is ongoing. | |

ESA = Endangered Species Act; IHA = Incidental Harassment Authorization; MMPA = Marine Mammal Protection Act; NMFS = National Marine Fisheries Service

#### 3.4.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

The LWI structures and SPE piles would affect availability of forage fish, salmonids, and other marine fish consumed by marine mammals (Section 3.3). Visual disturbance due to barge and other vessel traffic during concurrent construction of both projects may inhibit use of the project sites by marine mammals that frequent nearshore waters, such as harbor seals and sea lions, thereby reducing the area available for foraging, resting, and transiting along the waterfront.

Pile driving for the two projects would result in the combined number of exposures of marine mammals to underwater noise levels that exceed behavioral harassment thresholds shown in Table 3.4–25. The ranges shown in Table 3.4–25 account for differences between the individual LWI and SPE alternatives. These exposures would occur over a total of four in-water work seasons.

**Table 3.4–25. Combined Noise Exposures for all Marine Mammal Species for the LWI and SPE Projects**

| Species | Underwater Vibratory Behavioral Threshold (120 dB) | | |
|---|---|---|---|
| | Steel Piles | Concrete Piles* | Total |
| Steller sea lion | 250 – 470<br>(LWI-3+SPE-2) – (LWI-2+SPE-3) | 72 – 100<br>(SPE-2) – (SPE-3) | 322–570 |
| California sea lion | 4,500 – 8,460<br>(LWI-3+SPE-2) – (LWI-2+SPE-3) | 1,296 – 1,800<br>(SPE-2) – (SPE-3) | 5, 796–10,260 |
| Harbor seal | 30,535 – 67,705<br>(LWI-3+SPE-3) – (LWI-2+SPE-2) | 0 | 30,535–67,705 |
| Harbor porpoise | 620 – 1,195<br>(LWI-3+SPE-3) – (LWI-2+SPE-2) | 0 | 620-1,195 |
| Transient killer whale | 180 – 360<br>(LWI-3+SPE2/3) – (LWI-2+SPE-2/3) | 0 | 180-360 |
| **Total** | **35,835–77,720** | **1,296–1,800** | **37,131–79,520** |

dB = decibel

Note: * This project would not contribute exposures to concrete pile driving because neither LWI alternative would include concrete piles.